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AN OPAQUE SURVEY OF THE NASAL SINUSES

A METHOD FOR DIAGNOSIS OF THE ANATOMIC STATE OF THE SINUSES AND OF THE FUNCTIONAL CAPABILITY OF THEIR MEMBRANE[1]

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THE history of roentgen examination of the nasal sinuses may be divided into two periods. The first period began soon after the discovery of the x-ray by Roentgen in 1895, and concerned itself with visualization of the sinuses and interpretation of anatomic pathology as seen on x-ray films. The second period followed the demonstration by Proetz of the functional activity of the sinus mucous membrane. It concerned itself not only with anatomic visualization, but also with observation and interpretation of physical and physiologic phenomena.

Prior to roentgen examination, sinus disease was diagnosed only by clinical examination and mainly by intranasal inspection, transillumination, and probing. Suppuration was the outstanding disease entity of the sinuses. Cysts, thickening and degeneration of the sinus mucous membrane were purely operative findings. Neoplastic disease was diagnosed during life, usually after the neoplasm had expanded beyond the boundary of a sinus; otherwise, it was found at postmortem examination.

With the advent of roentgen examination, the criteria for diagnosis were mainly anatomic. The sinuses were regarded as two symmetrical groups of air spaces, diseases of which were manifested by various gross pathologic changes. Such changes were recognized on films by deviations from the so-called normal shadows. The deviations were interpreted in terms of aeration, membrane thickening, cysts, polyps, newgrowth and bone condensation and rarefaction. Thus by seeking anatomic changes, roentgen examination actually demonstrated the status or static characteristics of the sinuses. These were correlated to the symptoms and signs found on rhinoscopic and clinical examination; collectively they formed a basis for diagnosis and treatment.

Many rhinologists welcomed roentgenography, especially because they had found that intranasal signs were frequently insufficient or unreliable, and occasionally misleading, in the determination of sinus disease. On the other hand, there were just as many rhinologists who disregarded

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roentgen examination because roentgen signs did not always coincide with clinical symptoms. It was not uncommon to find apparently normal sinuses on roentgenographs of patients who complained greatly of symptoms referable to the sinuses. Furthermore, it was not uncommon to find considerable involvement of the sinuses on roentgenographs of patients who made little or no complaint, the sinuses being suspected for other reasons.

With the introduction of such fluid contrast media as were safe and satisfactory for use in the sinuses, a distinct aid to visualization of the maxillary sinuses and the anatomic defects thereof became available. In 1925, Proetz (1) developed a method for instilling fluid contrast media into all the sinuses, which method he termed "displacement." In collaboration with Ernst, he studied the characteristics of fillings of the total sinus system. Following up these studies of displacement fillings, Proetz and Ernst investigated the mechanics whereby the sinuses were emptied of the opaque medium. They observed the phenomenon of emptying on serial post-filling roentgenographs and pointed out that the functional state of the sinus mucous membrane could be estimated by such observation. Proetz demonstrated that the membrane that lines the sinuses is a kinetic structure, by virtue of a surface layer of ciliated columnar epithelium; that the cilia displayed a remarkable power to perform work; that ciliary activity is an important factor in maintaining the health of the sinuses and must, therefore, be considered a functional obligation of the mucosa. In addition, he emphasized the importance of patency of the sinus ostia. By this work, Proetz not only awakened the rhinologists to a physiologic conception of the sinuses, but also initiated the period of combined anatomic and physiologic roentgen examination.

For a number of years following the introduction of the displacement method of filling the sinuses, the writer, in his practice of otolaryngology, duplicated the technic of Proetz and Ernst in several hundred cases, and found it of inestimable value as a diagnostic procedure. It was performed in office, clinic, and hospital practice with equal facility.

From time to time, additions to and variations of the procedure and roentgen technic were tried; different routines were

Fig. 1.

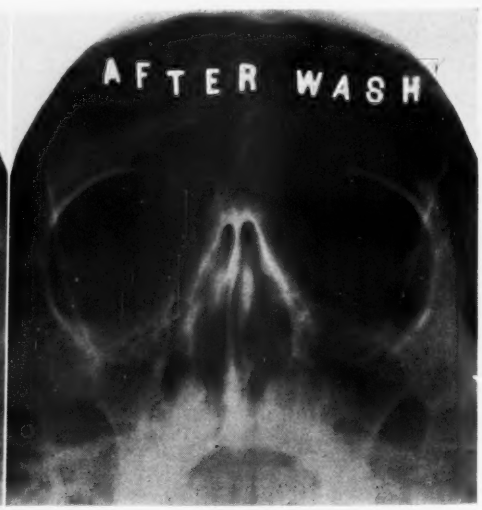


Fig. 2.

Fig. 1. History of nasal discharge for five years (Waters, erect).
Fig. 2. Antra irrigated; mucopurulent return from both (Waters, erect, after irrigation).

tested for their facility and faithful depiction of known clinical and surgical features. As a result, the routine about to be described was evolved for comprehensive study of the sinuses. It is termed an "opaque survey" (Table I).

An opaque survey consists of three phases, namely, the control study, the displacement study, and the maxillary study. Each phase is divided into two stages.

CONTROL STUDY: FIRST STAGE

Objects.—(1) To determine the general anatomic features of the sinuses, the state of aeration, and gross pathologic changes, by simple roentgenography; (2) The films of this study serve as controls for differentiating the shadows of metallic foreign bodies, fine and coarse bone lines, and dense structures, such as osteomas, from the shadows of the opaque medium to be studied on later films. Control films identify and direct attention to areas of pathologic significance which may be temporarily obscured by the opaque medium on later films.

Projections.—Fi ms may be stereoscopic or single, taken with head erect or prone. The minimum requirement is a nose-forehead (Caldwell), a modified nose-chin (Waters-Waldron), and a lateral skull. Right and left oblique (Rhese) views and a submental-vertex view are optional with the examiner.

CONTROL STUDY: SECOND STAGE

This stage is begun after study of the control films. In cases in which the maxillary sinuses appear perfectly normal on the control films, this stage may be omitted to save time. However, when there is the slightest doubt about aeration of the antra or membrane thickening, this stage should be performed.

Objects.—(1) To determine the presence of fluid, *i.e.*, serum, mucus, pus, jelled secretion, and retained medication, and to remove same. Regarding retained medication, silver preparations commonly used in the nose have been recovered on irrigation as late as two months after use. They cast a vague shadow in the antrum which may be misinterpreted unless a history of their use is known to the examiner; (2) to determine whether a haziness, density, clouding, or opacity of the antra is due to fluid alone and whether irrigation changes this appearance on a post-irrigation film.

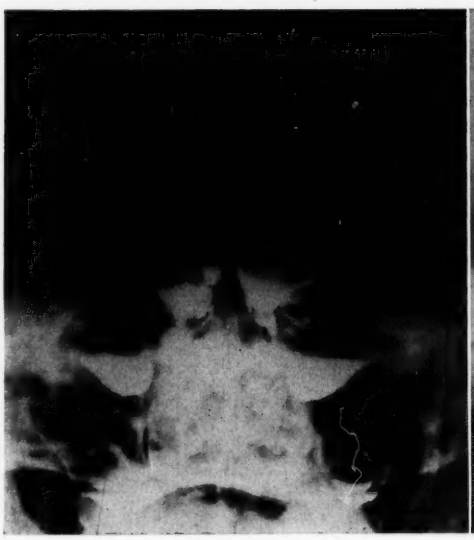


Fig. 3. Displacement filling: tip of nose projection.

Fig. 4. Displacement filling: lateral projection.

In many instances, the haziness persists in spite of the irrigation, indicating that the thickened membrane and not the fluid was casting a shadow (Figs. 1 and 2). Rarely does a clouded antrum clear completely as a result of irrigation.

Maneuver.—The antra are irrigated with normal saline after topical application of a local anesthetic and puncture in the inferior meatus. Puncture is preferred to cannulization of the natural opening for two reasons: First, entrance to the antrum is more certain by puncture, for it is well known that one cannot distinguish between ethmoidal and antral ostia with any certainty; second, edema of the ostium is quite likely to follow manipulation of a cannula in the ostium, and interfere with drainage later in the examination. It may also cause paresthesia, as pointed out by Proetz. Of the two methods, puncture is performed more rapidly, with less manipulation, and with little or no pain.

Projections.—Films are made before and after irrigation in the Waters position, head erect.

DISPLACEMENT STUDY: FIRST STAGE

Several days are allowed to elapse between this and the preceding stage, to permit any residual irrigating fluid in the antra to be evacuated. This precaution need not be observed when time is a factor, because it has been demonstrated that such slight residual fluid does not interfere with the study.

Objects.—(1) To determine the patency of the ostia and lumina of all the sinuses; (2) to visualize the location of sinus cells, their size, and their relations to each other and to adjacent structures, on various views.

Maneuver.—The total sinus system is filled with lipiodol by the displacement method. Displacement depends on physical laws. When fluid is added to a test tube the center of which is constricted, none enters the lower chamber. With suction applied through a cork in the test tube, air is drawn up from the lower chamber, producing a vacuum. Release of suction permits fluid to run down into the lower chamber to satisfy the vacuum. The lower chamber may be likened to a

Fig. 5.

Fig. 6.

Fig. 5. Displacement filling: oblique projection (cheek, nose, and chin touch cassette).
Fig. 6. Displacement filling: submental-vertex projection.

sinus lumen, the constriction to a sinus ostium, and the upper chamber to the nasal passage. Thus fluid displaces air; medium. The amount of opaque fluid unintentionally recovered in the suction bottle is an indicator of the amount of filling

TABLE I.—OPAQUE SURVEY OF THE NASAL SINUSES

Control Study	Displacement Study	Maxillary Study
First Stage *Object* 1. To determine general features and gross pathology. 2. To obtain control films for differentiating original shadows from those of the opaque medium. *Projections* *Required* 1. Nose-forehead (Caldwell) 2. Nose-chin, modified (Waters-Waldron) 3. Lateral skull *Optional* 4. Oblique (Rhese) (R. and L.) 5. Submental-vertex	*First Stage* *Object* 1. To determine patency of ostia and lumina of all sinuses. 2. To visualize the location, size, and relations of sinus cells. *Maneuver* Filling the sinuses with lipiodol by the Displacement Method *Projections* 1. Tip of nose—erect 2. Lateral—erect 3. Oblique (R. and L.)—erect (chin-nose-cheek) 4. Submental-vertex—erect 5. Vertex-submental—prone	*First Stage* *Object* 1. To determine the capacity of each antrum. 2. To visualize filling characteristics and defects. *Maneuver* Puncture filling the antras with lipiodol, measuring the amount accepted by each from a 20 c.c. syringe. *Projections* 1. Tip of nose—erect 2. Oblique (R. and L.)—erect (forehead-cheek-nose) 3. Nose-chin, prone
Second Stage *Object* 1. To determine the presence of fluid in the antrum and remove same. 2. To determine whether irrigation changes the appearance of the antra on post-irrigation films. *Maneuver* Irrigation of antra by puncture in inferior meatus. *Projections* 1. Waters—erect (before irrigation) 2. Waters—erect (after irrigation).	*Second Stage* *Object* 1. To determine the ability of the sinuses to empty. 2. To determine undue retention of the opaque. *Projections* 1. Tip of nose, erect. 2. Others, as required. (Every two or three days for one week or until empty.)	*Second Stage* *Object* 1. To determine the ability of the antra to empty. 2. To visualize membrane shadow changes. *Projections* 1. Tip of nose, erect (preferably 24 hours after filling, and every two or three days, until empty). 2. Others, as required.

because of this, Proetz termed the maneuver "displacement."

Granted a normal filling, the location and size of the sinuses and their relations are visualized more clearly and concisely than by any other method. To accomplish the filling, a total of from 20 to 30 c.c. of lipiodol is used. When all of it is taken up, and the patient has not swallowed or expectorated any of it, the assumption is that the sinuses are large, possess open ostia and patent lumina, and that they have readily accepted the oil. On the other hand, if most of the opaque medium is returned to the suction bottle, the assumption is that the sinus ostia are blocked or else their lumina are obliterated by thickened membrane or occupied by viscid secretion. Thin secretions are displaced, like air, by the opaque

accomplished. When considerable secretion is present in the nose, a displacement irrigation preceding the filling may enhance the latter. However, in the absence of secretion or discharge and in the event of a failure to fill, neither a preceding displacement irrigation nor a preliminary shrinking of the nasal mucosa, or both, will cause a retrial at filling to meet with any different success. Contrary to popular conception, filling is rarely enhanced by preliminary shrinking under any circumstances. With head inverted, no sinus will fill above the level of its ostium.

The displacement method is simple and non-traumatic. Its performance does not require more than a few minutes. The patient is more comfortable on a table than in a chair. Experience has shown that filling of the frontals is enhanced by

extension of the chin past the perpendicular chin-over-ear line of Proetz, the operator gently pulling the chin toward him. In this position of hyperextension of the head, all the ostia are placed in a horizontal plane. A perpendicular erected on this plane from the ear will cross the mandible midway between its angle and the chin in the majority of skulls.

Fig. 7.

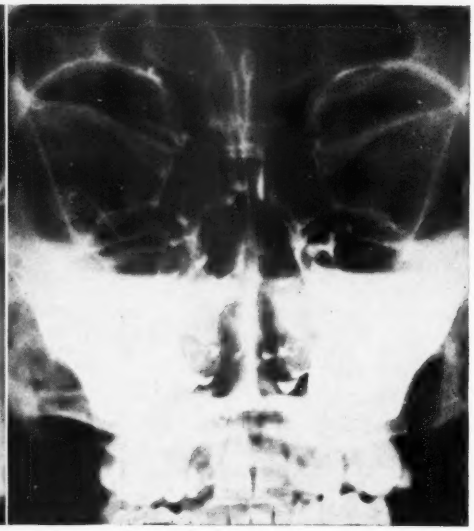


Fig. 8.

Fig. 7. Displacement filling: vertex-submental projection.
Fig. 8. Maxillary filling: tip of nose projection (17 c.c. of lipiodol in each antrum).

Projections.—Five single films are made in this stage. Stereoscopic films may be made for special reasons and always prove fascinating as well as instructive.

1. Tip of nose: head erect, tip of nose touching the cassette which is at 90 degrees, chin and forehead equidistant from the cassette. The central ray is horizontal and points to the nasal spine. This position offers an excellent view of the general filling. Opaque medium in the frontals seldom reaches the midline. Filling of a crista galli cell is occasionally found at the frontal floor in the midline. Below this level, any opaque medium that crosses the median line is in the sphenoids. At the sphenoid level, any opaque medium that extends lateral to the lateral nasal wall, and is hung seemingly at the medial corner of the roof of the antrum, is in a pterygoid cell. Opaque medium below the frontal, medial to the orbit, and not reaching the midline is in the ethmoid labyrinth, and appears broken into numerous units at varied levels. Opaque medium lateral to the nasal fossæ at or below the floor of the nose, and covering the thick alveolar process of the maxilla, is in the antrum. Thickened membrane and polyps may raise this level considerably. Rarely does the opaque medium fill more than a third of the antrum (Fig. 3).

2. Lateral: head erect, cassette at 90 degrees; the horizontal central ray pointing midway between the eye and ear. The distribution of the opaque medium in the various superimposed sinuses is noted. Ethmoid fillings may be distinguished as being in the anterior and posterior groups. Sphenoid filling is differentiated from pterygoid fillings by position, the latter being directly antero-inferior to the former. The nasofrontal ducts are occasionally

outlined sharply by the opaque medium. Periclinoid posterior ethmoid cells are sometimes discovered, filled, on this view (Fig. 4).

3. Oblique: the head so positioned that the chin, nose, and malar eminence or cheek touch the cassette which is at 90 degrees. The central ray is horizontal, at the level of the external canthus of the eye nearer the cassette. With this arrangement, shadows of the distal mastoid and petrous bones are thrown below the spheno-ethmoidal cell group. This projection throws the ethmoid into the homolateral orbit, allowing an excellent view of the relationship of the optic foramen, the sphenoid, and the posterior ethmoid cells. This projection does not separate the two anterior ethmoid groups as well as it does the two posterior groups (Fig. 5).

4. Submental-vertex: the patient seated, the head hyperextended so that the vertex rests against the cassette which is at 90 degrees; the central ray horizontal, midway between the chin and the hyoid bone. This view shows opaque medium in the antra, ethmoids, and sphenoids; it is employed particularly for outlining the posterior borders and lateral limits of the sphenoids. Frequently, opaque medium extends from each side of the sphenoids, outlining the pterygoids and giving the appearance of ball-like projections from the sphenoids. Notation of deviations of the sphenoid septum, seen only with this projection, is of considerable value to the rhinologist, especially when his treatment requires cannulization or exploration of the sphenoids (Fig. 6).

5. Vertex-submental: the patient seated, the chin extended forward over a cassette at about 25 degrees above the horizontal plane; the central ray at 90 degrees passes through the vertex to a point midway between the chin and the angle of the jaw. This view outlines the floor of each sphenoid; it is made possible by the spread of the opaque medium on the floor, the result of almost a 90-degree change in the position of the head. The overlapping shadows of the sphenoids and the posterior choanæ can be differentiated (Fig. 7).

DISPLACEMENT STUDY: SECOND STAGE

Objects.—(1) To determine the ability of the sinuses to empty; (2) to determine undue retention. This stage is concerned with recording the functional capability of the membrane which lines the sinuses. Films are made at approximately 48 and 96 hours after the filling. If there is retention at 96 hours, additional films are made thereafter at two- or three-day intervals, until all the sinuses are empty of the opaque medium. This stage may be terminated at the end of a week, if necessary, and the third phase of the survey may then be started.

Projections.—(1) Tip of nose, head erect, horizontal ray, single film, to duplicate the same position in the previous stage; (2) lateral and other projections may be made as suggested by the findings at 48 or 96 hours, and as prompted by the curiosity of the examiner. Normal ciliary activity will sweep the opaque medium out of the sinuses in from 24 to 48 hours, and in most instances before 96 hours. Occasionally, without discernible cause, a slight residue is found in one or two apparently normal sinuses for a considerably longer period.

MAXILLARY STUDY: FIRST STAGE

Objects.—The maxillary sinuses are filled by measured injection to determine their respective capacities and to visualize their filling characteristics and defects. The antrum is more often involved in sinus disease than any of the others. The data obtained from a study made of a complete filling exceed those obtained from displacement filling and more than justify the performance of this separate study.

Maneuver.—Topical application of a local anesthetic is made to the inferior meatus, specifically to the point where the attachment of the inferior turbinate angulates at the junction of its anterior and middle thirds. At this point the naso-antral wall is as thin as parchment and very little pressure is required for needle

Fig. 9. Fig. 10.

Fig. 9. Maxillary filling: oblique projection (forehead, cheek, and nose touch cassette).
Fig. 10. Maxillary filling: nose-chin prone projection.

puncture. It is essential to have the patient calm and co-operative. Hysterical patients should be dismissed rather than forced to submit, for, with force, one is apt to penetrate the outer and posterior walls of the antrum and inject the opaque medium into the pterygomaxillary fossa. Three such cases have been observed in clinic practice, in cases in which the above mentioned caution was not heeded. No harm came of it; the opaque medium remained fixed in the tissues for several months and longer. In another case, the filling was made into a very large pterygoid cell instead of into the antrum. After this was discovered, the puncture was directed anteriorly and the antrum was filled. The pterygoid filling was expelled within 48 hours, whereas the antral filling remained considerably longer. The fact that puncture filling is painless and safe is evidenced by its successful use in a number of children, the youngest of whom was three and one-half years of age. As a rule, this procedure should be reserved for patients past the age of six. After the antrum is punctured, the head is tilted to the side being filled, to favor filling, and slightly forward to permit the overflow to run to the nostril and to show on the upper lip. Injection is made slowly with a 20 c.c. syringe that has been filled previously with lipiodol. The tubing connecting the syringe and the needle is fitted with Luer-loks to make air-tight connection and to prevent spill of the oil. Resistance and a whistling or hissing noise indicate obstruction and a narrow ostium; free flow without noise indicates a patent ostium. At the moment the overflow is seen, a reading of the amount injected is taken on the syringe, allowance being made for the predetermined capacity of the connecting tube and needle. The same procedure is applied to the opposite antrum. The fillings are then roentgenographed.

Projections.—Three projections are utilized in this stage of the study.

1. Tip of nose: head erect, horizontal central ray pointing to the nasal spine. On this view, the opaque medium is seen

Fig. 11.

Fig. 12.

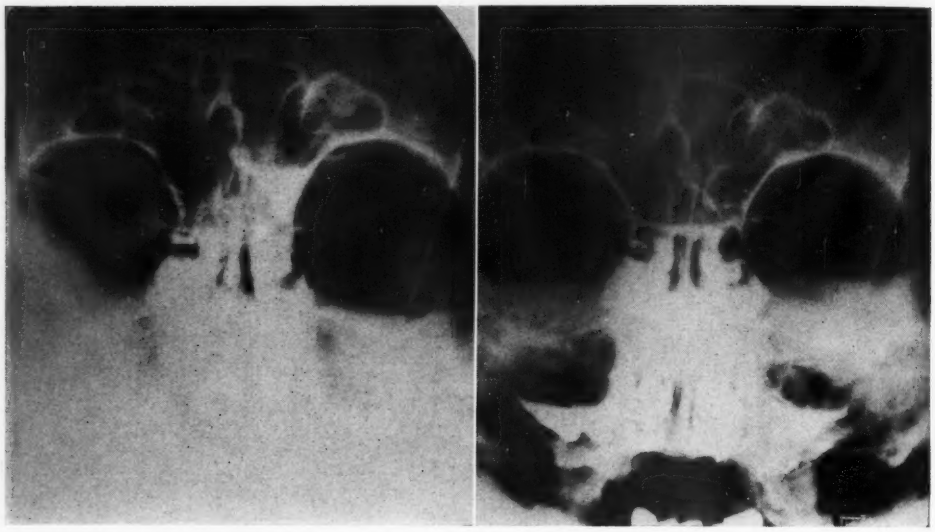
Fig. 11. Maxillary filling: nose-chin prone projection. (The lipiodol is flowing from the filled antrum into the ethmoid and supra-orbital ethmoid.)

Fig. 12. Maxillary filling: tip of nose projection. (Each antrum accepted 13 c.c. of lipiodol.) The normal fluid-level line is seen in the left antrum; the right antrum is filled to the roof.

to occupy and to outline the antrum from its medial to its lateral walls, resting on a concave floor from which it extends upward to the level of the ostium, where the shadow is that of a fluid level line. Not infrequently, the overflow can be traced through the ostium and over the surface of the inferior turbinate in a path to the floor of the nose. The membrane is clearly visualized as a black line that runs between the white outline of bone and the white mass of opaque. Normally this line is no thicker than a hair. As thickness increases, the density of black lessens and tends toward a gray (Fig. 8).

2. Oblique: right and left, head erect, horizontal central ray pointing to the nasal spine. The head is positioned so that the forehead, cheek, and nose touch the cassette which is at 90 degrees. In this position, the shadow of the distal mastoid is raised, permitting a clearer view of the lower half and floor of the antrum. There is a clear view of the relationship of the teeth in the upper jaw to the floor of the antrum. The posterior border of the antrum is sharply outlined, as is the lateral wall of the opposite antrum which appears shunted from the center of the film. Comparison of right and left oblique views for alveolar outline, lateral wall outline, and uniformity of opacity, is advantageous and informative (Fig. 9).

3. Nose-chin, prone: the nose and chin resting on a horizontal cassette, and the central ray perpendicular to the cassette, pointing to the nasal spine. The presence of opaque medium in the antra makes it possible to disregard the otherwise annoying shadows of the petrous pyramids (Fig. 10). The shift of the opaque medium permits it to outline the roof of the antrum, which appears convex and smooth, except where it is notched by the infra-orbital foramen. On this view, any alteration of the convex roof line indicates a pathologically thickened membrane. Furthermore, since the shifted opaque medium no longer weighs heavily on the mucosa of the floor, thickening in that area will be evident, whereas in the erect position it may have been obscured by the opaque medium. Another important finding on



A *B*

Fig. 13-*A*. Displacement filling: tip of nose projection. Note lipiodol in the right frontal sinus.
Fig. 13-*B*. Same position—retake film—15 minutes later. The right frontal sinus is now empty.

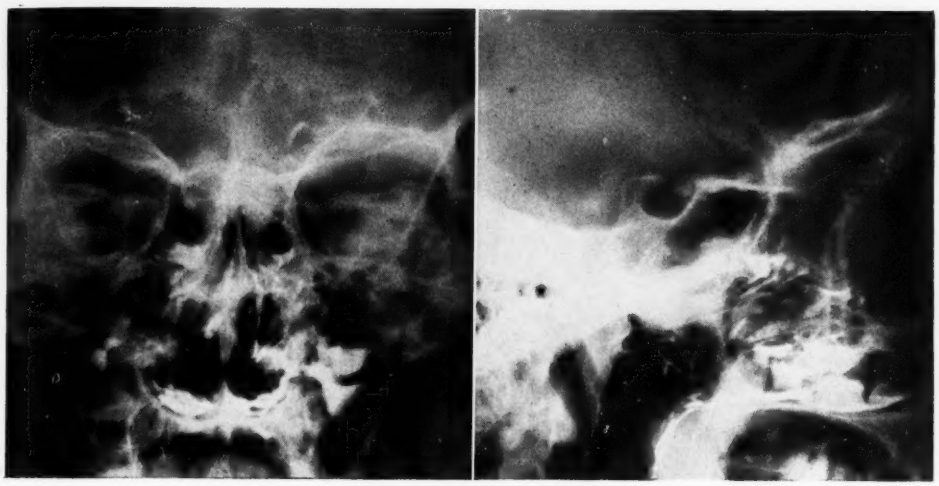
this view is that of confluency between the antrum and the ethmoid or frontal sinus. Such direct communication has been demonstrated anatomically but not roentgenographically, so far as the writer has been able to determine. The opaque medium is seen to pass directly upward, medial to the orbit, to occupy a position corresponding to the ethmoid sinus and occasionally to a supra-orbital ethmoid cell (Fig. 11). In some cases opaque medium is found not in the ethmoid but in the frontal sinus; its presence there can be verified on other views.

There are a few cases in which it is desirable to study a pathologic antrum singly, in order to obtain an unobstructed lateral view of the filling. In such cases, the tip of nose erect and a lateral erect projection may be made of the filled antrum; then the other antrum may be filled, after which the previously described routine is followed. It is rarely justifiable to study one antrum alone without a comparison study of its mate. It is also recommended that all cases of antral disease receive a complete dental examination, clinical and roentgenographic, for the purpose of completing the record, if for no other reason.

MAXILLARY STUDY: SECOND STAGE

Objects.—(1) To determine the ability of the antra to empty; (2) to visualize membrane shadow changes.

Projections.—(1) Tip of nose position, head erect, horizontal ray, single film; (2) views in the lateral and oblique positions may also be taken, according to the requirements of specific pathologic shadows. This stage is concerned with recording the phenomena of emptying. It is best to make the first film approximately 24 hours after filling, and subsequent films at two- or three-day intervals until the antra are empty. In this stage, pathologic thickening of the membrane may be revealed in spite of a previous appearance of normalcy in the displacement study and on the original films of the maxillary filling. In the displacement study the amount of opaque in the antrum may not be sufficient to reveal a pathologic thickening in the upper half of the antrum. On the original films of the antral filling, compression of



A *B*

Fig. 14-*A*. Displacement filling: tip of nose projection, April 24, 1938. Healed pulmonary Koch infection, allergy, and chronic pansinusitis. Note very poor filling after preliminary shrinking with adrenalin; note also the high antral floors.
Fig. 14-*B*. Lateral projection, April 24, 1938.

the membrane by the pressure of injection and the weight of the lipiodol may be so marked as to produce a nearly normal appearance. After some of the opaque medium has been expelled in the course of 24 hours or so, compression no longer applies, and thus newly formed outlines of the opaque medium and membrane may be seen. Expulsion of some of the opaque medium may be aided considerably by a tendency of the compressed membrane to rebound slowly on release of pressure. When the opaque medium reaches the level usually obtained by displacement filling, the thickening found above this level may not be visible again.

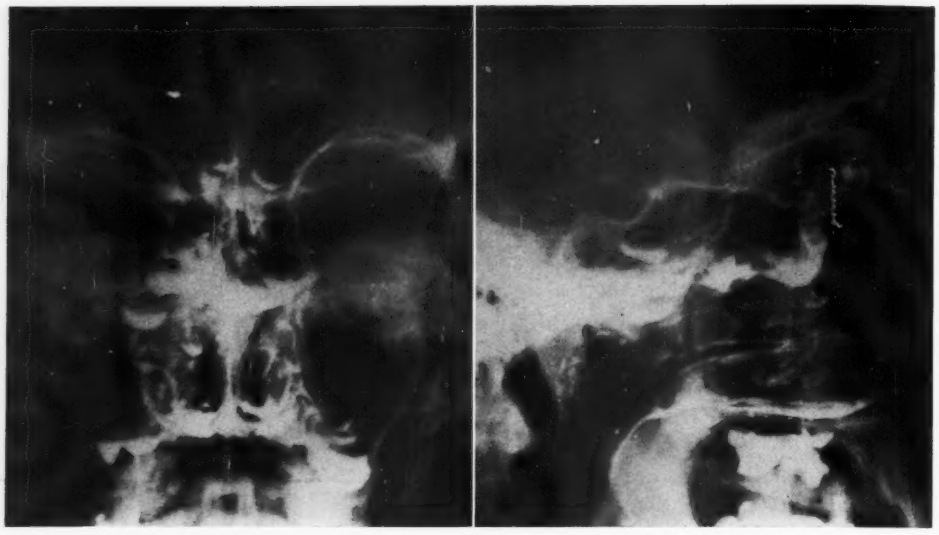
FINDINGS ON OPAQUE SURVEY

In totally normal sinuses, an opaque survey demonstrates anatomic normalcy when lipiodol is found in all the sinuses after displacement filling and when there is no filling defect in the antra after injection filling. Functional normalcy is demonstrated by the expulsion of lipiodol from all the sinuses within 96 hours.

On displacement filling, the quantity of lipiodol found in the different sinuses varies greatly; the solid shadow of the oil does not reach higher than the level of the ostium of any sinus except in the frontal; the antra are rarely filled more than half way and usually are only fractionally filled.

On injection filling, the normal adult antrum accepts about 15 c.c. of lipiodol, on the average; antra with a dense bony outline usually have a smaller capacity. If both antra are symmetrical, they normally accept similar amounts of oil.

An opaque survey demonstrates anatomic pathology and functional normalcy when it reveals one or more filling defects in spite of which the lipiodol is expelled within 96 hours. This finding occurs in cases of cysts which are surfaced with normal epithelium; in some cases of hyperplastic sinusitis with or without polyps, and in many cases of acute infection. Cases of acute infection, as a rule, evidence thickened membrane as a filling defect and a normal or hyperactive ciliary activity; but when the infection persists beyond a reasonable period of time, ciliary activity is slowed up or stopped, and empyema of the sinus results.



C *D*

Fig. 14-*C*. Same patient, Nov. 11, 1939, after roentgen therapy. Displacement filling without preliminary shrinking.
Fig. 14-*D*. Lateral projection, Nov. 11, 1939.

An opaque survey demonstrates anatomic normalcy and functional pathology when, in the absence of a filling defect, the lipiodol is retained beyond 96 hours. This finding occurs in several types of cases, all of which offer obstructed nasal respiration as a major complaint. It occurs in cases in which the nose is apparently blocked by hypertrophy and in others in which the nose is apparently endowed with sufficient breathing space. It occurs in recent cases of pollen allergy, and in cases which manifest sensitivity to thermal and atmospheric changes. It is the usual finding in cases of endocrine deficiencies and metabolic disturbances. It is common in hypothyroidism and artificial menopause, and has been observed in obesity, diabetes, the cachectic state, and after the climacteric.

An opaque survey demonstrates anatomic pathology and functional pathology when there are one or more filling defects and the lipiodol is retained beyond 96 hours. This finding is common in chronic infection, in allergy of long standing with or without secondary infection, in polyposis, and in cancer. In chronic infection the filling defect is uniform and is produced by hyperplastic and degenerative changes in the membrane. Delayed emptying and undue retention is the result of interference with ciliary activity. The ciliary activity is dependent on several factors. In infection, toxin may be a factor in disturbing ciliary activity and regeneration of ciliated columnar epithelial cells. Leukocytic infiltration is a common finding in chronic infection and may affect ciliary activity. In cases in which the membrane has become metaplastic, there are no cilia and, therefore, there is no functional activity.

The uniform thickening of the membrane frequently involves the ostium and produces an *intrinsic block* which results in a disturbance of ventilation, which, in turn, probably affects ciliary activity. Block of the ostium may occur on the nasal side of the ostium, in which case it is termed an *extrinsic block*. The ostium is so located in the nose as to be readily influenced by sudden changes in the nasal mucosa.

In allergy, recent cases may present normal filling and emptying characteristics. Edema of the sinus mucosa, however, delays emptying. Undue retention is not the rule. In cases of allergy of longer standing, there may be marked filling defects, total failure to fill, and varied but delayed emptying time. Undue retention is frequently found. The membrane borders on polypoid degeneration. Most cases of long standing allergy, with asthma, fail to fill at all by displacement. In the maxillary study, they show marked filling defects and undue retention; the later films often present a V-shaped residue of opaque medium at or near the floor of the antrum, which typical shape is considered pathognomonic of polyps.

Polyps cause irregularly shaped filling defects in the antra, with raised membranous floors, the opaque medium appearing central and medial in location. Peculiarly enough, some cases of polyps evidence normal emptying time. The polyps, on section, present a good surface of ciliated columnar epithelium. Occasionally such cases evidence an emptying time of 24 hours, which, in the face of a marked filling defect, may be due in part to a rebound from the compression produced by filling. This rapid emptying may be interpreted as a pseudo-hyperactivity. In most of the cases, however, there is usually a V-shaped residue that app oaches the floor as the opaque medium gravitates between the polyps, and which remains for an undue period of time. Displacement fillings vary but are usually poor. It seems that polypoid degeneration occurs sooner and more often in the antra than in the other sinuses.

Cancer will cause defects and failure in filling and delay in emptying in accordance with the extent of the lesion. A significant roentgen sign is irregularity of bone outline and absorption of bone.

ADDITIONAL OBSERVATIONS ON FILLING AND EMPTYING PECULIARITIES

The writer has demonstrated, at his exhibit of "Roentgen Studies of the Nasal Sinuses" (2), that edematous mucosa in the antrum may be compressed by the weight of lipiodol and the pressure of the injection to the extent that it appears to be of normal thinness; also that the actual thickness of the edematous membrane may be visualized by subsequent filling with an aqueous opaque medium, which, because of a considerably lower specific gravity, does not compress the membrane. In such cases the capacity estimation with the lipiodol may be twice as much as with the aqueous opaque.

In cases in which antrum filling reveals the opaque medium risen above the level of the ostium, and exhibits, instead of a fluid level line, a convex border that corresponds to the roof of the antrum, a diagnosis of blocked ostium is made (Fig. 12).

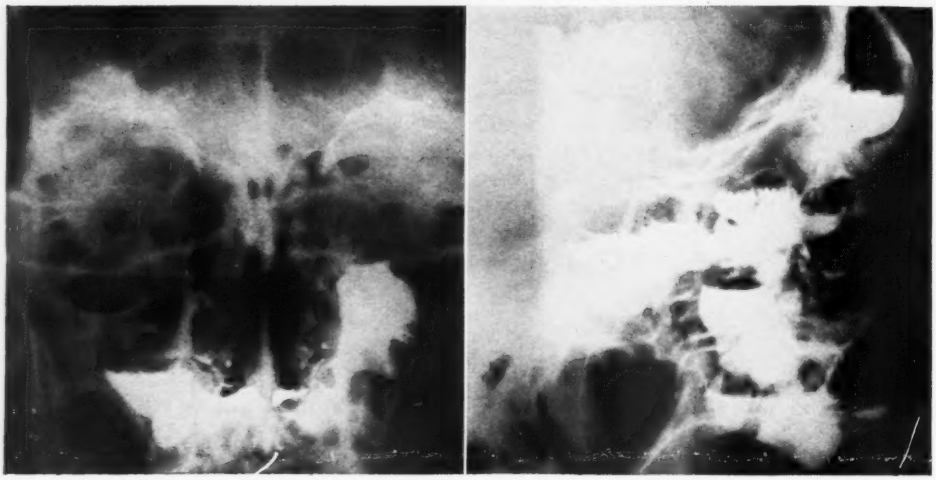
At one time it was feared that the opaque medium would leak out of the sinuses before they could be roentgenographed, but experience has proved that this fear was unfounded. Some patients were purposely placed in special positions for hours at a time, and other patients were given special exercises, all with the idea of hastening the so-called drainage of the oil from the sinuses. Drainage was not influenced.

The frontal sinuses are definitely an exception to all rules. Proetz thinks they are less likely to fill than are the other sinuses. The time interval between filling and roentgenographing was probably greater than 15 minutes in his cases. The writer's experience has shown frontals filled in the majority of those cases that were roentgenographed within a few minutes of filling. In these cases, the second or third film of the filling, taken five or ten minutes after the filling, showed the frontals empty or nearly so (Figs. 13-*A* and 13-*B*). This finding suggests that the frontals have the exclusive property of "losing" the opaque medium either by gravitation or active expulsion or both. Another peculiar feature in the frontals is the finding of opaque medium at the roof or along the side walls, soon after filling, evidently swept away from instead of toward

the ostium. This suggests reversal of ciliary current, a condition that has been found in the frontal sinuses of dogs. Specks of opaque medium may be found in nooks and corners and on the roof of a frontal sinus as late as ten days after filling.

In some cases of delayed emptying of the antrum, the opaque medium does not seem to lose its smooth and regular outline, and retains its fluid level line. This suggests that ciliary activity is not present. In other cases of delayed emptying, the original smooth outline, on later films, is corrugated and presents spike-like projections toward the antral walls; the fluid level line is lost, and in its stead is an irregular convex line that seems to reach toward the roof. The membrane shadow appears thickened and irregular on its free surface. This suggests a very active ciliary effort and a closed ostium. The membrane seems to be working under a load; on still later films in some of these cases, the outline of the residual opaque medium becomes smooth again, and the membrane shadow becomes thinner, allowing an impression of exhaustion.

Ordinarily, when the opaque medium has been unduly retained in an antrum and the examiner wishes to terminate the study, the residue may be delivered by an irrigation of the antrum. Several cases have been observed, however, in which the residual opaque medium remained after irrigation. There was no evidence of septa and accessory cells within the antrum, nor was there evidence that the opaque medium had been fixed by tissue cells at the sites of the shadows. An explanation for this finding is not yet available. It is also noteworthy that displacement irrigation in some cases of delayed emptying fails to dislodge the residue, which subsequently disappears.



A *B*

Fig. 15-*A*. Maxillary filling: through post-operative naso-antral windows: tip of nose projection.
Fig. 15-*B*. Same patient, lateral projection of displacement filling which was performed after films were made of maxillary filling.

Studies of emptying occasionally reveal opaque medium in an ethmoid or frontal sinus that was clear prior to the filling of the antrum, but never has opaque medium been observed to gravitate from the ethmoid into the antrum. This observation is regarded as evidence of predetermined pathways of ciliary currents.

In a recent case, the study of emptying revealed the sphenoids to be emptying

faster than the pterygoids, and as the quantity of lipiodol in the pterygoid with delayed emptying became less, the homolateral sphenoid, which had already been empty, was seen to contain the opaque medium again, in an amount corresponding to the loss from the pterygoid. Thus, it seems that this is the only method of demonstrating, in the living, the functional confluency of a pterygoid sinus with its homolateral sphenoid or posterior ethmoid cell.

INDICATIONS FOR OPAQUE SURVEY

The opaque survey is particulary indicated in—

1. Cases with persistent nasal symptoms and with few or no clinical findings, to rule out or establish changes in the membrane itself and in its functional activity.
2. Cases with persistent nasal symptoms and with positive clinical findings, which do not yield readily to treatment, to determine the location, extent, and type of the involvement.
3. Cases of constitutional disease resulting from focal infection, in which the upper respiratory tract is a possible focus.
4. Cases of bacterial allergy with asthma.
5. Cases of persistently recurring respiratory infection.
6. Cases of bronchiectasis.
7. All cases in which sinus surgery is contemplated.

(In previous papers (3, 4), the writer has contended that the indications for surgery of the mastoid are clinical and not roentgenographic *per se*. In contrast to this contention, it may also be said that the indications for surgery of the nasal sinuses are more readily found and substantiated by the roentgenographic evidence on opaque medium survey than by the clinical data. Naturally, in urgent and fulminating cases, time does not permit the performance of an opaque medium survey and, therefore, clinical judgment must prevail. However, in the vast majority of cases, neither time nor the cost of examination can outweigh the important information derived from an opaque medium survey.)

8. Cases of recurrent and chronic ear infection (4).

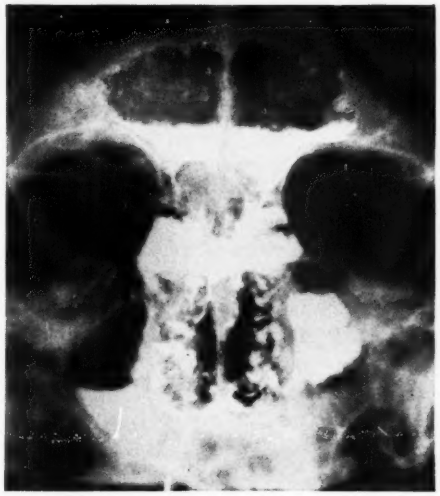


Fig. 15-*C*. Tip of nose projection of displacement filling.

9. Cases of neuralgia of the face.
10. Cases of brain symptoms referable to extension of infection from the sphenoid (5).
11. Cases of optic neuritis and iritis in which the cause is obscure.
12. Cases of sinusitis treated by x-radiation and otherwise, to check the results of such therapy.

For the purpose of checking the results of therapy, the complete survey may be made at suitable intervals (Figs. 14-*A*–14-*D*), or a "rapid survey" may be made, such as the writer demonstrated at his exhibit of "The Diagnosis of Paranasal Sinusitis" (6). This modification of the opaque survey consists of filling the antra and roentgenographing the fillings (Fig. 15-*A*), following which a displacement filling is performed and roentgenographed (Figs. 15-*B* and 15-*C*). The study of emptying is made as originally described. This method should be reserved for those cases in which a complete survey has already been made.

At the same exhibit the writer demonstrated the constancy of findings on repeated surveys of the same but untreated patient, showing comparable states at similar stages of the examination.

CONCLUSIONS

The opaque medium survey is a distinct aid to more accurate diagnosis, based on the conception that the sinus is a functioning entity and not just an air space; that a sinus is affected not only by local disturbances but also by constitutional disturbances, and that sinus disease is more commonly a disturbed physiology of the mucous membrane with its secondary histologic changes than a primary pathologic-anatomic entity. The opaque medium survey parallels, in no small measure, the modern roentgen diagnostic methods used in the study of the gall bladder, kidney, and gastro-intestinal tract. In other words, the opaque medium survey determines the dynamic as well as the static features of the sinuses. It is a safe and practical diagnostic method which has no contra-indications. It offers valuable topographic information for surgical procedures.

The opaque medium survey offers criteria for the evaluation of the physical state of the sinus mucous membrane and of its functional capability, on which a classification of sinus disease may be devised.

Adoption of the opaque medium survey as a method for further investigation of the sinuses should lead to a better understanding of the physiologic response of the sinus mucous membrane to infection, to therapy, to diet, and to variations in ventilation and climate. Worthy of investigation is the possibility that secretory disturbance of the mucous membrane, linked with its effect on ciliary activity, may be a factor in clinical manifestations of sinus disease.

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FACTORS INFLUENCING THE PROGNOSIS IN THE TREATMENT OF CARCINOMA OF THE CERVIX[1]

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IN the treatment of cancers, success or failure is measured by life or cure, or by failure or death. In reporting the end-results, little has been said about the patient's discomfort, disfiguration, or other unpleasant conditions following the attempt to cure. However, on admitting a patient, certain factors should be considered which may influence the final result, that is, cure or failure. The following pertinent questions then arise:

1. What type of cases are apt to offer a good prognosis, considering the five-year cure period?
2. At what stage in the progress of carcinoma do complications occur?
3. For what type of complications should we look?
4. Is radiation therapy responsible for such complications?
5. What type of irradiation may be considered most effective?
6. What conclusions may be drawn from the evaluation of statistics?

The recognition of early cervical carcinoma is of vital importance to every practitioner, as well as to the patient. It has been generally accepted that radiation therapy (radium and x-ray therapy) is the treatment of choice.

Type of Material at Bellevue Hospital.—After a close analysis of the type of material presented at the time of admission to Bellevue Hospital, we can derive some indications as to the importance of careful general and local studies of the patient and the disease. From 1925 to 1939, inclusive, 795 patients with carcinoma of the cervix were seen in the Radiation Therapy Department. In 261 of these cases the disease was so far advanced that the patients had to be transferred to the City Cancer Institute for custodial care, and of these, 182 died shortly afterward. Of the remaining 534 who were treated in Bellevue Hospital, 394 had parametrial involvement. Of the total 795 patients, 166 received only partial treatment. Of these, 145 are now alive and well, and all have been recently examined.

TABLE I

	No. Patients
Complete course of therapy at Bellevue Hospital	303
Treatment only partially carried out	166
Received treatment before admission to Bellevue	40
Hysterectomy performed before admission to Bellevue	25
Transferred for custodial care	261
	795

Grading.—Broders classified squamous-cell cancers into four groups, according to the differentiation of the cancer cells, in order to determine the malignancy of the cells. But there is no absolute knowledge by which we can determine which type is resistant or sensitive to irradiation. Some of the patients observed and classed as radioresistant, according to histologic study, have given excellent results, whereas others of the so-called radiosensitive type proved to be failures. The personal element plays too important a part in determining the cell type; frequently a series of microscopic slides classified according to this grading differed from the original opinion when they were reviewed later, even by the same investigator.

No effort was made to group our series of patients according to the histologic study, as it was felt that this could not be done because so much depends upon the interpretation of the individual examiner. The method for classifying the types of

[1] Read before the Twenty-fifth Annual Meeting of the Radiological Society of North America, at Atlanta, Dec. 11–15, 1939.

cancer of the cervix in use at Bellevue Hospital is based upon the anatomic classification adopted by the Cancer Committee of the League of Nations. All but three patients in our series had histologic studies.

General Condition.—The incidence of the disease is higher among the poorer classes. In planning to evaluate the treatment and anticipating results in carcinoma of the cervix, the general condition of the patient and the extent of the disease must be considered. The run-down, undernourished, indigent patient with poor social and economic status who must work hard and lives in unhygienic conditions and, in many instances, suffers from exsanguination from repeated hemorrhages, will not respond favorably to radiation therapy, even in the early stages, and certainly is much less likely to do so in the later stages of the disease. The prognosis depends largely upon the age of the patient, the symptoms and duration, the general condition before consulting her physician, the number of births, and the histologic grading of the cells.

Early Cases.—We rarely see a patient with cervical cancer before the ulceration and infiltration have extended into the deeper cervical tissues. Until the past four or five years no case could be classed as Stage I, and the greater number fell into Stage IV, as most of the patients had involvement of the surrounding tissue beside the local cervical lesion. Follow-up, in many instances, has been difficult.

In the few cases of Stage I which we have treated, complete healing has been obtained, with no recurrences, but these have not as yet reached the five-year period. No case of Stage IV has survived the five-year period. This brings the analysis to the cases that fell into Stages II and III. Many of these showed clinical evidence of parametrial involvement, but one cannot always be certain that the thickening or involvement was due to neoplastic invasion alone, because in most such cases infection was already present in the vagina or in the cervical ulceration, or even in the endometrium, which probably gave rise as well to infectious parametritis along with the malignant involvement. Such determination was clinically made on vaginal examination alone.

Extension of the Disease.—Carcinoma of the cervix begins primarily on the cervical lip, but in some cases in the endocervical canal. It spreads by direct extension into the paracervical tissues and *via* the lymphatics to the broad ligaments and the regional lymph glands. Extension of the cancer to the rectum may be revealed by manual or proctoscopic examination. It may be mild or extensive in character with occasional blockage of the gut by external pressure of the pelvic extension or direct cancerous invasion.

Effect on the Urinary Organs.—The kidneys are usually involved secondarily, due to infection or blockage of the ureters. Primarily, the disease remains medial to the ureter involving the tissues between them and the uterus. Later, as the cancerous condition advances, more extensive involvement takes place with blockage of one or both ureters. Thus before treatment is begun, kidney function tests, especially in patients with unilateral or bilateral parametrial involvement, are important to determine ureteral blockage and kidney destruction in order to care properly for such complications before irradiation is administered. Intravenous urography has been generally employed and resort to the more painful retrograde pyelography has been necessary only in those patients in whom the intravenous method proved unsatisfactory. For the past year urography has been done routinely and in a number of patients occlusion of a ureter was found, the result of cancerous invasion of the ureteral walls or from pressure of involved adjacent lymph nodes, which clinically presented no symptoms. It is of grave prognostic significance if a metastasis to the upper urinary tract is discovered before treatment is started.

Involvement of the bladder may be by direct invasion through the vagina or through the pelvis. Fistulæ may follow from malignant destruction of the vesico-

vaginal wall. Early involvement of the bladder may be determined by cystoscopy. Recently we have subjected all patients to such examination before administering therapy.

Treatment.—Because of its various manifestations, no standard method of treatment for all patients is possible, as irradiation by either x-ray or radium alone is not successful. Even in the early cases in which there is free lymphatic drainage from the cervix it is impossible to administer adequate irradiation to the lateral portions of the pelvis with local application of radium alone and x-ray therapy must be employed in addition, in order to reach these distant pelvic parts. We have noted such failures when patients have been treated by only one means of irradiation or incompletely treated elsewhere. The present-day treatment of carcinoma of the cervix at Bellevue Hospital has already been reported by Kaplan, and a more recent review of this form of therapy, "Irradiation of Cancer of the Cervix," by the writer, in the *American Journal of Obstetrics and Gynecology*, in December, 1939. Our method of treatment includes the administration of x-ray therapy to the pelvis, radium therapy to the cervix and uterus, and subsequent x-ray therapy to the pelvis four to eight weeks later.

Roentgen-ray therapy is usually started as soon as the diagnosis is established clinically and confirmed by biopsy. Periodic observations and examination of the patients following the completed course of irradiation is done at monthly intervals during the first year, and every three to six months during subsequent years. The statistical data previously reported have been based upon these results.

In the majority of Stage II cases, the results have been excellent; occasionally thickening in either parametrium was found on periodic examination. If there was no other associated disease, the patient was considered cured if she remained symptom-free. We may state, at this point, that patients who had a previous syphilitic infection show a tendency to earlier recurrence. It is our impression that this applies to the untreated syphilitic patient as well as to the treated ones, particularly in the younger age group.

Complications.—These may involve the skin, the urinary tract, the rectum, and the vagina, and be associated with intractable pain. In the Stage III cases, the complications as well as definite post-irradiation recurrences are more frequently observed, while repeated irradiation for recurrences in many instances resulted in the prolongation of the patient's life. However, if the dosage is given to the point of devitalization of the outlying carcinoma cells, there is danger of irradiation injury to the skin, bladder, ureters, and rectum.

Skin.—The injury to the skin is apparently from the slow vascular changes resulting in localized tissue devitalization; increasing and persisting subcutaneous infiltration occasionally leads to extensive necrosis. Pigmentation of the skin over the portals used for therapeutic irradiation is to be expected, and is not considered significant. Remaining vascular changes may occur in the form of telangiectasia. However, the later development of a marked subcutaneous infiltration which causes thickening and irregularity of the skin, in some instances, may be followed by sloughing. Idiosyncrasies of the patient, with special reactions of her skin, subcutaneous tissue, and blood and lymph systems, must be taken into consideration.

Urinary Tract.—The most frequent complication is urinary obstruction, edema of one or both thighs, due to pressure of the deep nodes on the lymphatic drainage system or blood vessels or both. Without laparotomy, however, it would be difficult to determine the extent of the damage to the urinary tract from the extension of the disease. Ureteral obstruction and resulting kidney damage found in many patients were most likely due to the encroachment of the carcinoma. Ewing states: "The natural termination of most cases of uterine cancer is through uremia from occlusion of the ureters." This view has been supported by Kaplan in a study of autopsy

reports, at the New York City Cancer Institute. Irradiation alone, without the presence of disease in the uterus, is unlikely to cause obstruction, else all patients treated by irradiation would show damaged ureters, which is not the case. It is possible, however, that unrecognized partial obstruction from the extension of the neoplasm had existed prior to irradiation. The spread of cancerous growth, or possibly the edema and healing fibrosis that follows the regression of the tumor from irradiation, may also produce such symptoms. Pressure of the deep pelvic nodes causing extrinsic compression of the ureters may also occur.

In a series of 257 patients, Graves, Kickham, and Nathanson found 70 per cent of ureteral obstructions apparently due to carcinomatous extension. For these patients sometimes catheter drainage, nephrectomy, or ureter transplantation may relieve the condition.

Pelvic Nodes.—In patients with deep pelvic-node involvement, the most frequent clinical finding is marked edema of the leg on the involved side, from the pressure on, or occlusion of, the feeding lymphatics. In some patients postural positioning may aid drainage and give relief. In some instances x-ray therapy to the pelvis is effective. Most often the condition is unrelieved by any means at our disposal. Sometimes proctitis, more or less severe, may follow irradiation and in some instances it is already present before treatment is started. Its etiology is in most cases obscure.

Rectal.—If rectal irritation is persistent, small ulcerations of the rectal mucosa may develop, which when healed may result in stricture, which may persist in spite of all measures of relief. It is always a serious condition and calls for extreme efforts to control it.

Vaginal.—Vaginal complications were uncommon in our series. Sometimes extension to the vagina necessitated intensive irradiation by way of the vulva route. Occasionally pruritus, more or less severe, followed such treatment. Burning on urination because of the intensive erythema following irradiation was annoying to some patients. Ulceration of the adjacent parts occurred rarely and was due to some technical fault in treatment. Excoriation and slough from radium excess within the vagina was an infrequent occurrence. Fistulæ were rare in our series.

Vaginal Fistula.—In dealing with a fatal disease such as carcinoma, radical measures may be considered justifiable if the procedure selected gives the patient the best chance of a cure or a reasonable benefit, even though some unfortunate sequelæ may result. Vaginal fistula is one of them. Behney found that the incidence of vaginal fistula is less in treated than in untreated patients, but results were compared only in patients with advanced disease. Some authors suggest that the type of therapy plays an important part in this complication. This is undoubtedly the case, but on our service at Bellevue Hospital we have never had a patient develop a fistula due to irradiation alone. Among our treated patients were six with vaginal fistula, but the fistulæ developed before or during the period of treatment and we believe that they were due to the cancerous destruction of the tissues and not directly attributable to the irradiation. A fistula is always a serious complication and calls for the employment of experienced and ingenious methods of relief. Depending upon the site of the fistula, whether into bladder or rectum, appropriate measures are employed to relieve the condition. In most instances, only palliative measures are indicated because of the cancerous invasion of the tissues through which the fistula leads and radical reparative surgery is not applicable. In some cases we found the employment of a sea sponge in the vagina, as suggested by Kaplan, to be of some relief. Transplantation of the ureters may offer some help in vesical fistulæ. Colostomy at times may be less offensive than a recto-vaginal fistulæ and be more agreeable to the patient.

Pain.—Pain is one of the most devastating complications from which some of these

patients suffer. It may be due to local ulceration or destruction, extensive pressure involvement of the pelvic nerves by metastatic growth, or direct invasion by the cancer into the nerve sheath. When medication no longer controls such patients we have resorted to nerve block with alcohol, or even nerve section, chordotomy being most frequently employed for this form of therapy. Only in a few instances were these measures of avail, in most cases the patients succumbing in marked distress in spite of all measures toward attempted relief.

Advance of the Disease.—It is difficult to state how long the carcinoma had existed before the patient consulted a physician or attended a clinic, and that is true even in early cases. However, a number of patients who were classified as Stage I when first seen and received little or no therapy, or the treatment was interrupted, were found to be Stage III-*b*, or even IV-*a*, when they returned six or eight months later. Two such patients with this early type, seen in 1938, were completely hopeless six months later and showed extension to both parametria. One also had involvement of the bladder and the other had extension to the deep inguinal nodes. The disease in both was squamous-cell carcinoma of the transitional cell type. It seems, therefore, even judging from just these two patients, that in from six to eight months the disease can progress from Stage I to Stage IV.

Hysterectomized Patients.—In the postoperative cases referred to us, effort was made to ascertain whether or not the disease was present before the supracervical or the complete hysterectomy had been performed. However, it was impossible to get conclusive information in every suspected instance, as to the clinical and histologic appearances of the cervix at the time of operation. The time factor, therefore, served as the criteria for determining this question; that is, the interval elapsing between the removal of the uterine corpus and the development of carcinoma must be sufficiently long to dispel all reasonable doubt that a malignant tumor was not present at the time of operation. Upon this basis, the cases considered as newly developed cancers were those in which at least a year had elapsed between operation and the onset of the symptoms of cervical carcinoma. One patient in our group had a complete hysterectomy, in 1916, for carcinoma of the cervix, followed by radiation therapy elsewhere, and, in 1932, she was referred to our service at Bellevue Hospital as a hopeless recurrent case. Radium and x-ray therapy were administered at this time and the patient is still alive and well, and is symptom-free seven years after the last treatment However, we were unable to obtain a section of the original lesion for a comparative histologic study of the biopsy at the time of our treatment. Was this a late recurrence or a new lesion? We were unable to answer this question definitely. We treated the case as that of a primary malignant lesion at the time of admittance to Bellevue Hospital.

Treatment of Carcinoma of the Cervical Stump.—Difficulties are encountered in the treatment of carcinoma of the cervical stump, and poor results are invariably reported. Because of the anatomic distortion from previous laparotomy the application of proper irradiation is made quite difficult. The poor results obtained from irradiation have been attributed to the absence of the uterine body, which may prevent the correct application of a sufficient dose of radium. It has been intimated that as a result of faulty application, normal tissues are frequently over-irradiated and that peritoneal accidents as well as fistulæ to the bladder and rectum are apt to occur. The absence of the uterine body would not seem to increase materially the complications from external irradiation. Kaplan and Healy have repeatedly emphasized the importance of roentgen irradiation for the treatment of parametrial disease and they have pointed out that an adequate dose of radium applied to the cervix is capable of controlling the disease only in and directly adjacent to the cervical tissues. In the statistical reports of the treatment of

carcinoma of the cervix, external irradiation alone has seldom been sufficient in effecting a cure.

Distant Metastasis.—The patient usually succumbs to uremia as the result of urinary obstruction, or from pelvic infection and exsanguination, but distant metastasis from cervical carcinoma is rare. We have seen only two patients with metastasis to the bones. One had metastasis to the tibia which was described, in 1932, and was proved by roentgenologic and histologic studies. In the other patient, metastasis to the skull was found on roentgenologic examination.

Stage IV cases were, in most instances, too far advanced and in too poor a physical condition for any type of treatment. The complications associated with such patients were numerous and extensive, and they were treated symptomatically only, with the purpose of relief of pain. Death was a merciful occurrence in these cases.

SUMMARY

In correlating the final results with the clinical findings before therapy was instituted we found that:

1. In cases of Stages I and II, a good prognosis may be given with reasonable assurance if proper treatment is employed.

2. In Stage III prognosis should be guarded, as grading will depend upon the personal experience and interpretation of the examiner. Some cases closer to Stage II will give good results, while others closer to Stage IV, or borderline cases, may not respond at all.

3. Histologic grading may help but in some cases of Stage III epidermoid carcinoma we may fail, while in other Stage I or in presumably radioresistant cases we may obtain a cure.

4. No patient with a truly Stage IV grading has survived the five-year period.

5. Some cases clinically diagnosed as Stage IV were not really as advanced as they were believed to be from the first examination, as associated infection had interfered with the proper interpretation of the case. It is quite impossible to separate some cases from the hopeless and to make a definite prediction as to the outcome until the infection is cleared up.

6. If at all possible, treatment may be attempted even in clinically hopeless cases, with an occasional success.

7. Success in all cases is governed by the general condition of the patient, stage of the disease, quality of irradiation employed, continuity of treatment, and individual susceptibility.

8. Complications arising from the extent of the disease upon admission, as well as concomitant diseases, will influence the prognosis.

9. Complications arising during and as a result of the treatment are discussed.

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RADIATION OF CANCER OF THE CERVIX[1]

By FREDERICK W. O'BRIEN, A.B., M.D., Boston City Hospital, *Boston*

RADIUM element became a part of the therapeutic resources of the roentgen department of the Boston City Hospital in 1923. From that time until 1935, inclusive, a 13-year period, 289 patients with cancer of the cervix were seen in consultation with the gynecological service. Twenty-seven were judged unsuitable for any form of radiation therapy. Two hundred and sixty-two cases remain with history as to prodromal symptoms, physical findings, biopsy, radiation data, and follow-up believed adequate enough from which to deduce certain statistics and conclusions of value, at least intramurally.

The average age was 50 years and nine months. The youngest patient was 21 and the oldest 82 years of age. Hemorrhage was the usual presenting symptom that brought the patient to the hospital, pain rarely. The average duration of the bleeding for the group was eight months. This would appear extraordinary if one did not reflect that women, especially of middle life, are apt to minimize the significance of this danger signal.

The duration of the bleeding was not indicative of the stage of the disease. As often as not, recent hemorrhage, especially if massive, was found associated with advanced disease.

In classifying the cases as to clinical stage of disease, the League of Nations (1) system was adopted and is as follows:

Stage I.

The growth is strictly limited to the cervix uteri. Uterus mobile.

Stage II.

Lesion spreading into one or more fornices with or without infiltration of the parametrium adjacent to the uterus, the uterus retaining some degree of mobility.

Stage III.

(*a*) Nodular infiltration of the parametria on one or both sides extending to the wall of the pelvis, with limited mobility of the uterus or massive infiltration on one parametrium with fixation of the uterus.

(*b*) More or less superficial infiltration of a large part of the vagina, with a mobile uterus.

(*c*) Isolated metastases in the pelvic glands, with a relatively small primary growth.

(*d*) Isolated metastases in the lower part of the vagina.

Generally speaking, all cases not falling into Stages II or IV will be placed under Stage III.

Stage IV.

(*a*) Cases with massive infiltration of both parametria extending to the walls of the pelvis.

(*b*) Carcinoma involving the bladder or rectum.

(*c*) The whole vagina infiltrated (rigid vaginal passage), or one vaginal wall infiltrated along its whole length with fixation of the primary growth.

(*d*) Remote metastases.

At a casual glance, this division of the stages of cancer of the cervix appears involved. Actually, in practice, it is simple and resolves itself into the clinical grouping of early, borderline, advanced, and palliative cases.

Table I indicates the grouping of this series.

Such a preponderance of hopeless material presenting itself may be ascribed partly, at least, to the social status of the entrants to a large municipal hospital.

[1] Read in part at the Fall meeting of the New England Obstetrical and Gynecological Society, Boston City Hospital, Dec. 6, 1939; and at the Annual Meeting of the Radiological Society of North America, at Atlanta, Dec. 11–15, 1939.

TABLE I.—CANCER OF THE CERVIX, IRRADIATED AT THE BOSTON CITY HOSPITAL 1923–1935

League of Nations Classification	Clinical Class	No. Cases	Per Cent Total
Stage I	Early	53	20.2
Stage II	Borderline	38	14.5
Stage III	Advanced	81	31
Stage IV	Palliative	90	34.3
Total		262	100

One hundred and eight received a single radium application prior to transfer to home or a cancer retreat. Twenty-eight were given more than one application of radium. This was at a time when supplementary x-radiation had not become customary and the gynecological service had a limited number of beds, best utilized, it was thought, for the acutely ill. Most of these patients were lost completely to follow-up.

Eighty-one had a single radium application followed by a cycle of high voltage roentgen rays; 39 had more than one radium treatment and x-radiation cycle; three had roentgen therapy prior to radium insertion, and three had roentgen-ray therapy only.

During the period covered by this report our available radium consisted of eight monel metal needles of 12.5 mg. each. Bare needles were often the method of choice in the pioneer work. This was followed by the use of intra- and extracervical applicators of 2 mm. brass, as our knowledge of the importance of filtration increased. No single dose exceeding 3,000 mg.-hr. continuous radiation intra- or extra-cervically was prescribed. This seemed the part of wisdom since the radiologist did not make the application nor again examine the patient. Schmitz (2), as early as 1922, demonstrated by isodose curves that to avoid permanent injury or destruction of the mucosa of the posterior bladder and anterior rectal walls one should not extend the application of 50 mg. radium element beyond 48 hours.

With the installation of 200 kv. generators, in 1930, roentgen rays have been used routinely in conjunction with radium but more effectively since the appearance of Arneson and Quimby's (3) data, in 1935, on the distribution of roentgen radiation within the female pelvis. Two anterior and two posterior portals are employed. Six portals, suggested by Arneson (4), seem ideal but have not been used because of the time factor involved in a department already utilized to the limit of its capacity. The establishment of a tumor clinic has made it practicable to make use of high voltage roentgen rays, as proposed by Healy and others (5), prior to as well as after radium. The work of Meigs and his associates, referred to later, seems to confirm amply the wisdom of this order of procedure. Our supply of radium has been increased in amount and is now in 5 and 10 mg. platinum needles with a variety of applicators so that the radium application can be much better individualized.

The number of cases treated yearly is shown graphically in Chart I.

A search of the records of those patients treated up to and through the year 1933, reveals only one case[2] of cancer of the cervix surviving more than five years. A follow-up clinic was begun at this time so that it is now possible to report a small group of cases—28 in number—that have been followed for five years. These are classified in Table III where it is seen that seven survived in comparative comfort for five years, a salvage of 25 per cent.

These figures compare favorably with statistics published by similar institutions but probably are not representative. An analysis of the 1935 cases, as yet incomplete, indicates a lower five-year salvage rate. The indicated survival rate, however, for the Stage I cases has advanced to 60 per cent as against 42.8 per cent for the 1934 cases.

Experience points to the efficacy of repeated examination of the patient during the observation period with repetition of

[2] No. 543. H. H., aged 33, biopsy report on May 8, 1930, read: "highly malignant, undifferentiated epidermoid carcinoma." The patient was given 2,400 mg.-hr. of radium, intra-cervically, and not seen again until June 13, 1939, when pelvic examination disclosed no evidence of disease.

TABLE II.—RADIATION TREATMENT

Single radium dose	108
Multiple radium doses	28
Single radium dose plus x-rays	81
Multiple radium doses plus x-rays	39
X-rays plus radium plus x-rays	3
X-rays only	3
	262

the radiation when indicated. This has been stressed by Scheffey (6) and others.

To expect that a single application of radium alone or in combination with roentgen rays should eradicate every cancer of the cervix is a misapprehension resulting from failure to recognize the natural history of the disease and the limitations of radiation.

All patients who lived for five years had repeated radiation. Of the 1934 group, two had two applications of radium with two pelvic cycles of roentgen rays; four had one radium application and two or more cycles of roentgen ray, while one received three applications of radium, so that re-radiation would appear to have been an important factor in the prolongation of their lives. One patient was still living and free from demonstrated disease throughout the sixth year; all the others had cancer at the end of the five-year period and died in the sixth year. The term "cure" would be a euphemism if applied here. Nevertheless, the disease was arrested definitely and the patients lived in relative comfort. What more is done for organic disease elsewhere? This has always seemed to me an important aspect of cancer control that should be stressed more in propaganda to the public.

The amount of the initial dose of radium prescribed in this clinic has often been criticized, perhaps justly so, but radium dosage expressed in millicurie- and milligram-hours in itself means little unless examined critically in relationship to the kind and amount of filtration, distance, and method of application, whether continuous or interrupted. As analyzed by Lucas (7), when these factors are properly evaluated the radiation intensity and effect are about the same in the major clinics here and on the Continent.

To the informed, the idea that if a small dose does not accomplish a desired result, an arithmetical increase in millicuries destroyed or radium element will, has long since passed into the oblivion it deserves. The therapeutic limit of safety is about 3,500 mg.-hr., for a single continuous application when radium is introduced into

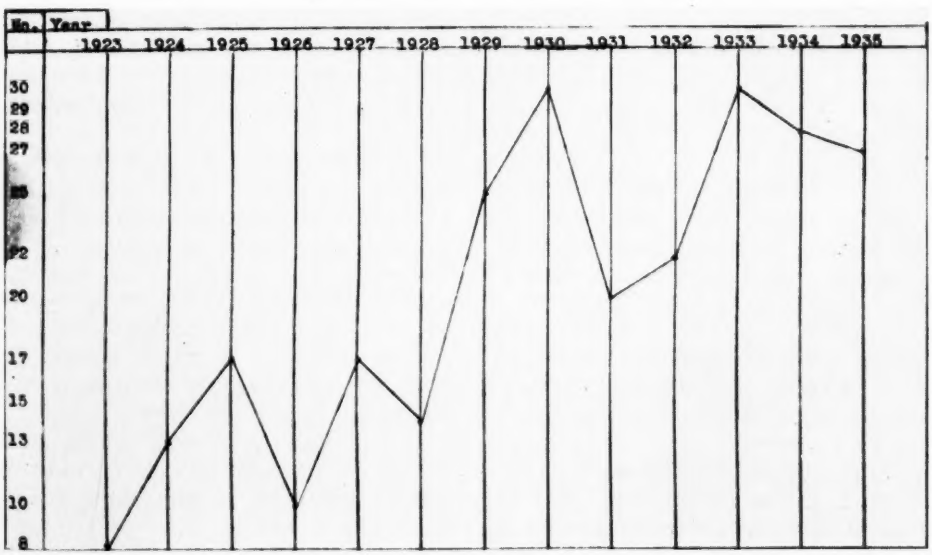

Chart I.

TABLE III.—CARCINOMA OF CERVIX, 1934

Clinical Groups League of Nations Groups	Clinical Class	No. Cases	Per Cent Total	Five-year Salvage No.	Five-year Salvage Percentage
I	Early	7	25	3	42.8
II	Borderline	3	10.7	1	33.3
III	Advanced	6	21.4	2	33.3
IV	Palliative	12	42.8	1	8.3
Total		28	100	7	25

the cervico-uterine canal. Arneson states that to increase the dose intra-cervically to 5,000 mg.-hr. increases the danger of irreparable necrosis and slough without increasing the biologic effect.

Large amounts of radium or radon element are not necessary to treat adequately cancer of the cervix that is amenable to this form of therapy. As little as 60 mg. of the salt, or its equivalent in radon to be destroyed, may be used if one wishes to follow the technic of the French school where protracted irradiation is followed in the belief that thereby more cancerous cells in the process of division will be devitalized. It must be noted that the large total dose of the French school, from 6,000 to 8,000 hours, is a composite dose divided between the cervico-uterine canal and the parametria. Seldom does the cervico-uterine canal dose exceed 3,000 hours.

There is no proof that the end-result is any better when 30 mg. are used intracervically for 100 hours than when 100 mg. are used for 30 hours. There is, however, convincing histopathologic evidence that the biologic effect bears a direct relationship, among other things, to the distribution of the radium intra-cervically. The use of long needles with a centrally placed cell—even though placed in a cervico-uterine applicator—will produce a strictly localized reaction as against the diffuse reaction obtained with properly placed cells, needles, or tubes in tandem and series.

The urgent need is to increase the radiation effect in the parametria. This can be accomplished in the early cases by the use of the colpostat (or modification of it), an instrument devised by the French school for directing radiation chiefly to the vaginal fornices. It must be stressed that its use is strictly limited by favorable anatomic conditions. After placement, a roentgenogram should be made to record its exact site. A lateral shift of the colpostat or any vaginal applicator may well be a factor in over-radiation of the ureters. Long radium needles of low radium content placed interstitially have been used with notable success by Pitts and Waterman (8) but this maneuver is not one for the inexpert. Supplementary high voltage x-radiation is now recognized as more advantageous generally for increasing the radiation effect in the parametria than attempting to increase the radium dosage.

Meigs and Dresser (9), combining roentgen rays and radium in their treatment of cancer of the cervix, at Pondville, employed a radium dose of 3,000 mc.-hr., 50 per cent less than at the other clinics with which they were associated, stating that the method seemed by far the most gentle and with results (three-year follow-up) that compared favorably with their clinics utilizing larger radium doses.

Meigs and Jaffe (10) have followed this material through for five years with results that are "eminently satisfactory" which is an understatement in view of their challenging figures. One cannot help but be impressed by the apparent importance of x-radiation prior to the application of radium.

Burnam (11) recently stated: "My associates and myself, on the average, have used less milligram-hours than most of the groups in this country and abroad. Nevertheless, in recent years since we began using x-ray in conjunction with the radium, our tendency has been further to reduce the radium dosage." It would appear then that radium dosage at the Boston City Hospital has not been too much out of line, economic necessity, among other things, unwittingly having been instrumental, doubtless, in preventing fruitless damage to tissues.

In surveying the group of cases presented

here it seemed evident that the extent of the disease rather than the pathologic histology determined the end-result. This generalization has received confirmation in a specific way from Chambers (12), pathologist to the Marie Curie Hospital, who analyzed 500 cases with a view to finding out in how many instances a uniform method and radiation technic caused the growth to disappear at its primary site, taking into account the histologic type. She concluded there was comparatively little difference in response between the histologic grades. The highest percentage of local cures was obtained in the transitional type of squamous cancer and in the adenocarcinomas but none of the histologic grades showed a difference of more than 15 per cent in either local cure or in the number of three-year survivors.

It is realized that in this brief presentation many important phases of the subject have not been explored. If, however, the ground work has been laid for future statistical study the primary purpose has been fulfilled.

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THE TREATMENT OF CARCINOMA OF THE CORPUS UTERI[1]

DESCRIPTION OF A NEW HYSTEROSTAT

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CARCINOMA of the corpus uteri is a serious disease, the prognosis of which is much more grave than one has been led to believe. Statistical evidence is gradually being accumulated to indicate that intra-uterine radium followed by hysterectomy and supplemented with x-ray therapy yields better results than either method alone.

However, the frequent finding of local vaginal and parametrial recurrences, the occasional finding of distant metastasis in moderately advanced cases, and the fact that the five-year cure rate is probably less than 50 per cent, indicate that there is still room for perfection of our treatment technic. Recognition of the necessity for improving the radium technic by developing a flexible and adaptable radium applicator which will more homogeneously irradiate uterine cavities of various sizes and shapes constitutes the radiation problem.

It is the purpose of this presentation to describe a new radium applicator, called "hysterostat," which attempts to meet the geometric requirements of the irregular sizes and shapes of uterine cavities more accurately than do the applicators in use at the present time.

The cavity of a uterus involved with corpus carcinoma is frequently more irregular both in size and shape than the normal uterus. Thus, in one small group of cases previously analyzed by the author, the measurement of the length of cavities of 15 uteri with corpus carcinoma from the external os to the fundus was: 6, 7, 7, 7, 8, 8, 8, 9, 9, 9.5, 10, 10, 10, 10, 15 cm. This small series of uteri gives some indication of the variation in length of the uterine cavities encountered. The larger ones tend to be ballooned out.

Uterine cavities involved with corpus carcinoma are not only irregular in size, but also in shape, the distorted contour usually being due either to a bulky carcinomatous mass or to the presence of fibroids. Stacy states that fibroids are three times as frequent in uteri containing corpus carcinoma as in uteri without it. Thus an ideal radium applicator must be so adaptable and flexible as to be capable of evenly distributing radium tubes throughout such irregular uterine cavities.

The insertion of a single radium tandem obviously provides inadequate distribution of radium foci in those portions of the corpus most commonly involved with carcinoma.

The Y-shaped applicator is a great improvement upon the single tandem but it has several drawbacks: there are some limitations to its adaptability to uteri of various sizes and shapes; the fact that two radium tubes are simultaneously inserted into the cervical os compels the use of thin capsules and, consequently, rather weak filtration; and more recent studies of radium isodose curves indicate that the amount of radiation coming from the ends of radium tubes is small (Fig. 5). Therefore, the perpendicular relationship of the two forks of this applicator to the fundus is such that the fundus may not be homogeneously irradiated and receives effective dosage only near the two areas where the ends of the radium tubes touch the fundus. A more ideal applicator would be one with a crosspiece. Dietel and Strauss have devised applicators which have attempted to overcome some of these deficiencies. The

[1] Presented before the Twenty-fifth Annual Meeting of the Radiological Society of North America, at Atlanta, Dec. 11–15, 1939.

most effective method, to date, of homogeneously irradiating the uterine cavity is by filling it with radium tubes. This has been done in various ways, *i.e.*, small tubes, bulky tubes, special wires attached to each tube, etc. I have used this method for seven years and it is ideal in small uteri, wherein from seven to ten tubes will fill the uterine cavity. Even then, chance dictates whether or not one of these tubes will rest flat against the fundus and irradiate it properly. Since many of the uteri under consideration are of medium or large size, the multiple-tube method is less satisfactory. The tubes tend to clump together and drop to the most dependent part of the uterus (Fig. 1), thereby over-irradiating this part and under-irradiating the upper part. This was overcome, to an extent, by using two or more rubber radium tandems, but even these did not satisfactorily irradiate the fundus. Furthermore, though originally placed against the lateral walls of the cavity, they tended to migrate to the center of the cavity as a result of muscular contractions, and remain clumped together. In spite of this, however, the use of multiple tandems assures a more diffuse distribution of radium foci than isolated tubes; and, when used in conjunction with a few single tubes placed in each cornu and against the fundus, frequently provides a satisfactory distribution of radium in small uteri.

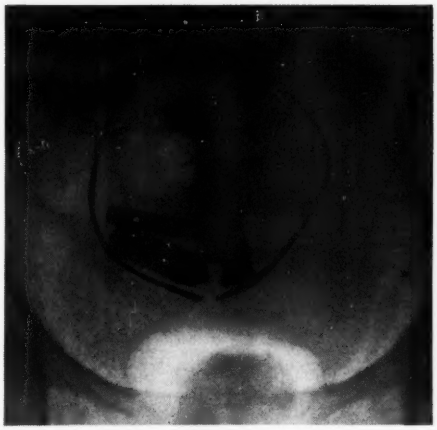

Fig. 1. Roentgenogram showing six rather bulky radium tubes in the uterine cavity and demonstrating the occasional inefficiency of the multiple-tube technic. Though the uterine canal measured only 8 cm. long, the cavity was ballooned out and large. Note the clumping of the radium tubes at the bottom. The fundus was inadequately irradiated and the residual tumor recurred.

DESCRIPTION OF NEW APPLICATOR (HYSTEROSTAT)

The applicator, or hysterostat, presented herewith, is so adaptable that it can be fitted to uterine cavities of various sizes and shapes and still maintain a diffuse distribution of radium foci. It consists of a crosspiece and several (two to four) lateral tandem inserters. To the ends of the crosspiece and the lateral tandems are attached stainless steel shells for the radium tubes.

The crosspiece (Fig. 2) consists of a stem (*E*) made of a long, thin tube, to one end of which is attached, by means of a hinged joint (*I*), a shell (*G*) to contain the radium capsule. The shell is made of stainless steel 0.004 mm. thick. To the other end of the stem is attached a handle (*A–F*). The stem measures 2.5 mm. in outside diameter, and is 28.5 cm. long, including the handle. The tubular stem is attached to the center of the radium shell by an external, hinged joint (*I*). One portion of the wall of this end of the tubular stem is cut away to permit the emergence of the central wire or rod. The end of this wire is flattened and attached to one end of the radium shell by means of an axle joint. Thus there are two hinges on the radium shell. The size of this shell varies and must be constructed to accommodate the available radium capsules. The outside measurements of the shell illustrated herein are 5.7 mm. in diameter and 27 mm. in length.

Attached to the other, or handle, end of the tubing is a special slotted-sleeve device which can be rotated (*C*). The slots are four in number and of different lengths (*D*). They predetermine the angle that the radium shell will form in relation to the long axis of the tubing. The inner wire has a knob (*A*) attached to it for convenience in

handling. Attached to the side of this wire and the knob is a flange (*B*). In order to introduce the crosspiece inserter into the uterine cavity, the knob at the end of the central wire is pulled out. This revolves

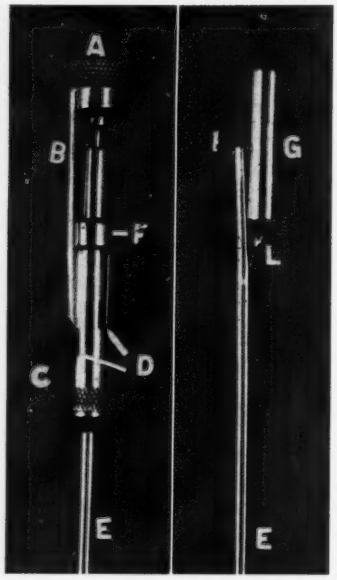

Fig. 2. The crosspiece. The handle end is on the left; the radium end on the right. *A*, knob on end of inner wire or rod; *B*, flange which is attached to knob only, and which slides into the slots (*D*) in the revolving sleeve (*C*). The flange must be pulled below the fixed guard (*F*) before the sleeve can be rotated. *E*, tubular stem through which runs the central wire. At the radium end of the crosspiece is the shell (*G*) which can be unscrewed and a radium capsule inserted. This can be made any desired length by inserting extra pieces. The shell is attached by a hinged joint (*I*) to the end of the tubular stem (*E*). The central wire emerging from the tubular stem is attached to one end of the shell by means of an axle joint (*L*).

the radium capsule so that it lies parallel to the long axis of the tubing, permitting its insertion through a slightly dilated cervical canal. When the end of the capsule is felt to touch the fundus, the knob on the central wire is pushed inward and the flange attached to it slides into the above mentioned notched slots on the rotating sleeve. The height of the notch selected predetermines the distance that the flange, and hence the central wire, will travel, and thus determines the angle which the radium shell will maintain in relation to the long axis. The flange must be pulled down below the guard (*F*) before the notched sleeve can be rotated to bring the appropriate slot in line. The maximum angle is 90°, which would place the radium tube in a transverse position resting against the fundus. The flange also serves as an external indicator of the position of the crosspiece in the uterine cavity.

The four lateral tandem inserters are not fixed instruments, but consist of sixteen separate pieces which can be screwed together to make various shapes (Fig. 3). The stem of the inserter consists of a flat metal strip 28 cm. long, 2.89 mm. wide, and 0.67 mm. thick. To the handle end is attached a knob, and to the radium end is soldered one-half of a radium shell. The other three pieces of the lateral tandem consist of a straight tubular section, threaded at each end with a male and female thread to hold one radium capsule, an angulated section, each half of which will contain one-half a radium capsule, and, finally, a terminal tip to enclose one-half a radium capsule. The angle sections come in two angles, 150 and 165°, and there are two of each in a set of applicators.

Figure 3-*A* illustrates the distribution of the hysterostat in a uterus of small average size which measures 6 cm. from the external os to the inner wall of the fundus. This distribution holds four radium tubes, the outside length of which is 23 mm., diameter 4 mm., and wall thickness 1.5 mm. platinum. Both lateral tandems have been shortened, so as to contain two tubes and one tube each, respectively. The angle is 150°. The angulation in the single-tube lateral tandem is obtained by bending the stem, which is made of a flat, flexible piece of stainless steel. Figure 4-*A* is a positive print of a self-exposed photogram of the radium as arranged in the applicators in Figure 3-*A*. Scattering blocks of beeswax

were placed below the x-ray film and on top of the applicators which rested on the film, thus providing a somewhat more accurate illustration of energy distribution than photograms made in air. The photogram gives an approximate idea of the distribution of the radiation energy. Photometric measurements were found to be subject to the usual fallibilities inherent in this procedure. The isodose curves based on

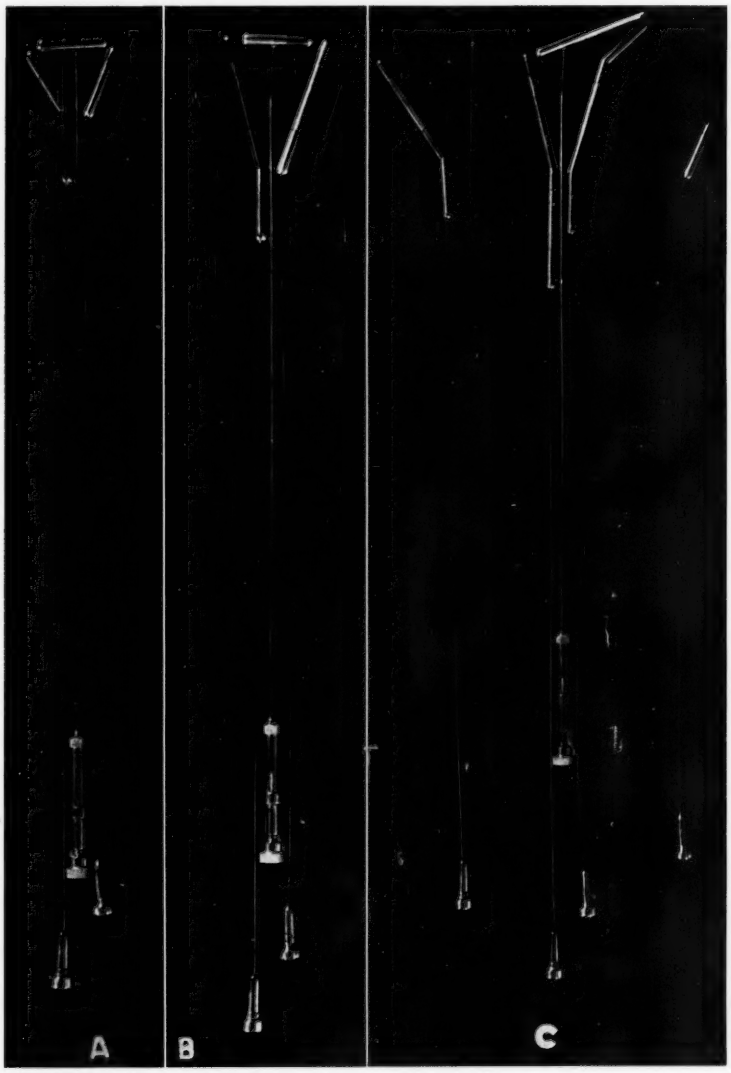

Fig. 3. Crosspiece and lateral tandems arranged in three different hypothetical distributions. *A*, arrangement for four tubes in a uterine cavity 6 cm. long. One lateral tandem contains a 150-degree angle section. The other lateral tandem is angulated by bending the flat stem. *B*, arrangement for six tubes in a uterine cavity 8 cm. long. This has been done by screwing an extra section into each lateral tandem. *C*, arrangement for a large, irregular uterus containing multiple fibromyomas and a carcinoma in a cornual *cul-de-sac* (see Fig. 4-*C*). The extra two lateral tandems are available in case the body of the uterus can accommodate them. Note that each arrangement of the applicators provides one radium tube in the cervical canal.

them provided inaccurate pictures of the energy distribution. Figure 5 is a photogram illustrating the distribution of energy around a radium tube. Except for a central linear beam, the radiation coming from the ends is very weak, due to the increased thickness of platinum traversed by a beam emerging tangentially from the tube. Parker has measured this in detail. This diminished radiation from the ends of the tube has been frequently observed by us when treating linear keloids with a linear tandem composed of several radium tubes which are placed in contact with the skin. When a dose large enough to produce a severe erythema is given, the erythema will be found to lie under the middle three-fifths of the length of the radium source, whereas little or no erythema will be found under the ends of the tube. Furthermore, the photograms in Figure 4 show that, although the cornu is irradiated by the long axis of two radium tubes, nevertheless, it receives less radium energy than other parts of the myometrium.

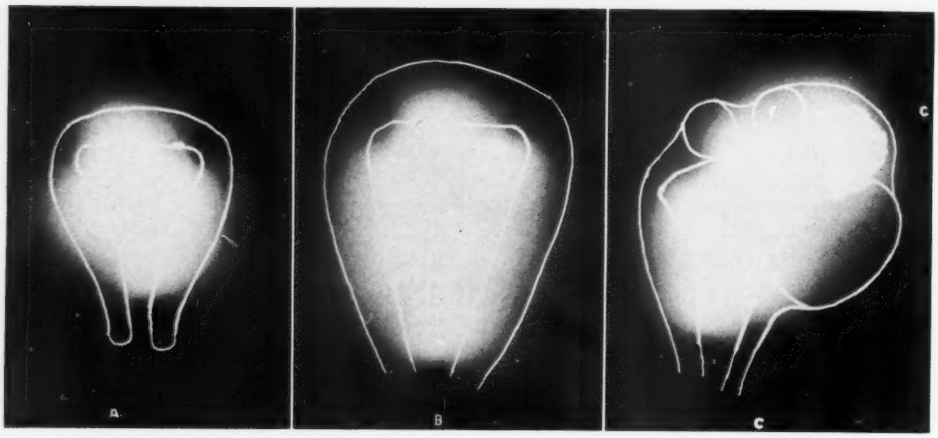

Fig. 4. Photograms of applicators in the various arrangements illustrated in Figure 3. The radium applicators were placed in direct contact with an x-ray film and scattering blocks of beeswax were placed beneath the film and on top of the applicators. *A*, uterine cavity 6 cm. long; *B*, uterine cavity 8 cm. long. *C*, large, irregular uterine cavity containing multiple intramural fibromyomas (*F*), and a carcinoma located in a cornual *cul-de-sac* (*C*). Observe the distribution of the radium energy throughout the myometrium. The small amount of radiation which is emitted from the end of a radium tube is demonstrated by observing the cornua, which are bombarded by two tubes. Even in Figure 3-*C*, in which the cornual *cul-de-sac* is occupied by two parallel tubes in direct contact, there is a relatively decreased amount of radiation in the cornual myometrium.

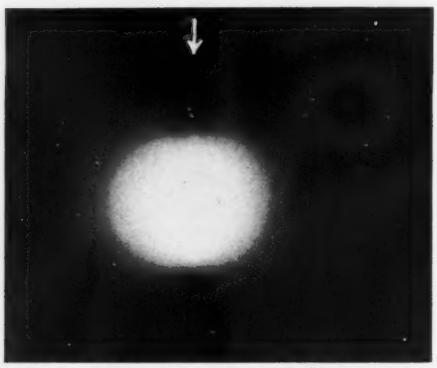

Fig. 5. Photogram made by placing the crosspiece of the hysterostat in contact with an x-ray film. This exposure was made in air, without any scattering blocks. Note the small pencil beam of radiation (white arrow) coming from the end of the tube. The blank areas on either side are caused by the increased thickness of platinum traversed by the rays passing obliquely through the wall of the tube. The importance of this area of diminished radiation is well illustrated in Figure 4-*B*, in which radium tubes in tandem formation with the ends touching one another exhibit areas of decreased radiation at the ends.

Figures 3-*B* and 4-*B* illustrate the distribution of the hysterostat with the respective photogram for a larger uterine canal measuring 9 cm. long. Six radium tubes are distributed throughout the cavity.

The angle of one lateral tandem is 165°; angulation of the other tandem being obtained by bending the stem. In a wide fundus, the end of the lateral tandem fits into the cornu (Fig. 3-*B*); in a narrow fundus, the crosspiece does (Fig. 3-*A*).

Figures 3-*C* and 4-*C* illustrate the distribution of the hysterostat and the respective photogram of a hypothetical large uterus with multiple fibromyomas and a carcinoma in a cornual *cul-de-sac*. The radium crosspiece has been lengthened by the insertion of an extra section to hold two radium tubes. The third and fourth tandems are available to be placed against the anterior and posterior walls of the uterus should the distance between these two be very large.

TECHNIC OF INSERTION

The cervix is first dilated and the uterine cavity outlined with the aid of a Schmitz caliper. The outline of the cavity is then drawn on a sterile towel with an applicator stick dipped in iodine or metaphen. The hysterostat is prepared by screwing the various sections together to provide proper arrangement of the radium foci to fit inside this outline. If the uterus is small, 15-mg. radium tubes are used. If the uterus is large and can hold many radium capsules, then 10-mg. radium tubes are used. The dose is usually administered over a period of three or four days.

The crosspiece is first inserted, the radium capsule being held parallel to the long axis of the stem of the applicator. When it touches the fundus of the uterus, the knob on the handle is pushed in, thus rotating the radium capsule into a position perpendicular to the long axis of the stem. It is moved around slightly in order to be sure that it lies snugly against the wall of the fundus, and at the same time it may be used as a probe to see if there is any additional space in either cornu to accommodate the tip of a lateral tandem. With a little experience, the crosspiece can be of great help in determining the contour of the fundus.

The lateral tandems are next inserted.

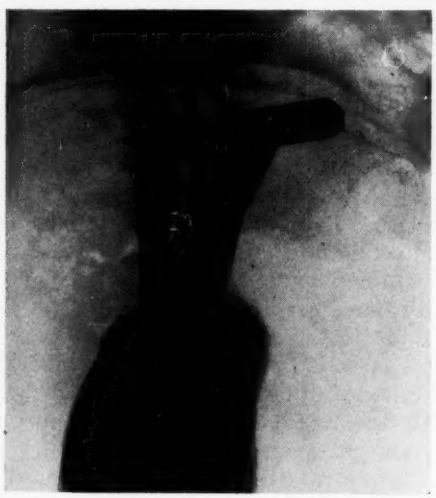

Fig. 6. Patient B. W. Roentgenogram of the pelvis showing a hysterostat containing six tubes, two of them being in the crosspiece. A dose of 6,240 mg.-hr. was given. When subsequently removed the uterus was found to be free of cancer.

Fig. 7. Patient B. R. Long narrow uterus. The long vertical tandem was angulated, with the upper portion pointing posteriorly. The hysterostat contained seven radium tubes. A dose of 6,000 mg.-hr. was given. The uterus was subsequently removed and found to be free of cancer.

One tandem is usually longer than the other, due to the presence of an additional radium tube which will lie in the endocervical canal. The shorter tandem is inserted first. Special care should be taken to determine that the radium reaches each cornu, either by means of the crosspiece in a small uterus (Fig. 3-*A*) or by means of the lateral tandems in a larger uterus (Fig. 3-*B*).

After the applicators have been inserted, a string or rubber band is tied tightly around them, just outside the cervical os, in order to fix them in their relative positions. This step is quite important, for, unless carefully done, the applicators may move out of position. The vagina is then packed with gauze, and the packing held in place with a male T-binder.

On the afternoon of the operation, or on the following morning, roentgenographs are taken to determine the position of the applicators. If they have shifted from position, they can be readjusted by manipulation of the protruding handles; if they have moved considerably, adjustment can be made with the aid of the fluoroscope. Experience has shown this to be rarely necessary.

DOSE

The dose to be given is still empirically determined, as the calculation of the distribution of energy in terms of equivalent roentgens, especially within the first half centimeter of a radium tube, is still not completely satisfactory. With a primary filter of 1.5 mm. platinum and a secondary filter of 0.4 mm. steel, a dose of 1,000 mg.-hr. per radium tube may be given. If the uterus is quite small, so as to contain only four radium tubes, a dose of 4,000 mg.-hr. may be given. This is the smallest dose we have given. If the uterus is larger and contains more tubes, then the dose per tube is from 900 to 1,000 mg.-hr., depending upon whether the tubes are situated close together or far apart. The largest dose we have given was 7,660 mg.-hr., in a uterus measuring 9 cm. long and into which we had inserted a crosspiece and two lateral tandems containing 8 tubes of 13.3 mg. each. This uterus was removed four weeks after the radium treatment. The normal myometrium showed very little radium effect, grossly or microscopically, but the defect in the corpus formerly occupied by the tumor was lined with a thin fibrinous membrane. There was no residual carcinoma or normal endometrium. Thus the hysterostat permitted the application of unusually large doses of radium to the uterine cavity with safety.

RESULTS

During the past two years, 13 patients with corpus carcinoma have been treated with the hysterostat (Table I). Eight were subjected to a total hysterectomy within from four to six weeks after the radium treatment. Seven of the eight uteri showed no residual cancer. The eighth one had residual cancer in the outer layers of the myometrium, in both ovaries, the omentum, and in many other parts of the peritoneum. This patient had received 6,480 mg.-hr. in the uterine cavity. Undoubtedly the tumor in the uterus must have been bulky so as to render the distance from the radium to the serosa relatively large. In another case, the removed uterus was free of cancer, but one ovary and the omentum were involved. Since we are considering for the present only the efficiency of the applicator in treating carcinoma in the corpus itself, this result was considered satisfactory.

Five patients were not operated upon. Three of these are alive and well for one-

TABLE I.—RESULTS OF RADIUM TREATMENT WITH HYSTEROSTAT

(13 Cases)

No Post-radium Hysterectomy			Post-radium Hysterectomy	
Poor Result	Patients Well	Untraced	Residual Carcinoma Found	No Residual Carcinoma Found
1	3 (0.5, 1.5, 2 yrs.)	1	1	7

half, one and one-half and two years, respectively. One patient with an advanced lesion died four months after the radium treatment. Her uterus was probably not sterilized, as uterine bleeding recurred. This was probably due to the fact that her uterus was large—10 cm. long—and a dose of only 5,371 mg.-hr. was given, or 597 mg.-hr. per radium tube.

Included in this series were patients treated not only in Bellevue Hospital, but also at the Sydenham Hospital and Hospital for Joint Diseases, New York City, and the Newark City Hospital.

SUMMARY

A new radium applicator, called "hysterostat," for the treatment of carcinoma of the corpus uteri is described. It is an efficient one, as seven out of the eight uteri treated with it and subsequently removed were found to be free of cancer.

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DISCUSSION OF THE PRECEDING THREE PAPERS

ROBERT E. FRICKE, M.D. (Rochester, Minn.): Dr. Rosh has given us an excellent survey of an exceedingly important subject. I think the main point of value, which she sufficiently emphasized, is that, to determine the prognosis, a careful clinical examination of each individual patient is necessary before treatment is started at all.

In my own mind, the factor influencing prognosis in treatment of carcinoma of the cervix is, first, the stage of the disease. At the Mayo Clinic we use the international classification, as Dr. O'Brien has done. To determine the stage, we need a careful general physical examination of the patient, as well as a pelvic examination, cystoscopic and proctoscopic examinations, and, when indicated, determinations of blood urea and the making of urograms.

There is also another group of patients we see especially at the Mayo Clinic which we classify as a modified group. These are patients for whom previous surgical treatment or cautery or radiation has been employed, obviously inadequately, since the disease has not been eradicated. In these cases, the prognosis is not so good, but we still classify them as a separate modified group in Stages I, II, III, and IV. Frequently, quite good results are obtained.

Another factor in prognosis would be, I think, the gross aspect of the lesion. The medullary or cauliflower type of growth seems to respond better to treatment, whereas the infiltrating or ulcerated type, with loss of tissue and formation of crater, does not appear to have so good a prognosis.

A third factor which we believe important is the age of the patient. In studying several hundred patients treated a few years ago, we found that those who were in the usual age group—40 to 60—appeared to have the best outlook when five-year cures are recorded. The younger group, below 40 years of age, do not do as well, as a rule, probably because of the greater rapidity of the growth and the more widespread metastases which occur in lesions of patients in this group. The older group, patients over 60 years of age, are prone to have degenerative diseases which affect the outcome.

Fourth, diseases associated with cancer, such as secondary anemia arising from hemorrhage, make the outlook bad and such patients have to be treated before

the radiation treatment is administered, as a rule. In a weakened individual who has little resistance, acute complications may occur during the course of the treatment. Syphilitic tubercular tissues appear to tolerate radiation poorly; there seems to be a delay in healing.

Fifth, prognosis is more favorable if we can give adequate treatment, carefully planned; that is, if treatment is not interrupted by spread of the infection or by hemorrhage.

Another factor is the co-operation of the patient in returning regularly for re-examination; this is most essential.

Last, I agree with Dr. Rosh and with Dr. O'Brien that in view of the present state of our knowledge, microscopic grading is not a factor in prognosis. However, I believe we should continue with it, and in the future we may learn a great deal from it.

IRA I. KAPLAN, M.D. (New York City): I shall speak first of Dr. O'Brien's paper which is important and instructive because it represents a wealth of material such as is seen in a large hospital which deals with the municipal type of patient. In private practice not everyone sees this type of patient, and, when he does, he usually transfers such patient to a municipal hospital. This has been our experience in New York where, as Dr. Rosh has told you, we have handled close to 800 patients in a period of time equivalent to that covered by Dr. O'Brien in his report.

Dr. O'Brien showed you on the screen the classification established by the League of Nations. We, too, have found that to be the most useful method of determining how and what we have to treat.

As Dr. Fricke rightfully said, age is not so important except in the younger age group. In this group we have more doubt as to our ability to control the disease because of the power of cancer cells in the young to grow more rapidly.

The summation of the clinical grouping, as Dr. O'Brien gave it to us, was very good. We have the early, the borderline, and the advanced cases. However, in our series we were not able to equal the early group case number that Dr. O'Brien had.

Like all municipal hospitals, the greatest number of patients are of the indigent type, and due to economic and other conditions the care and the follow-up of these patients is extremely difficult.

We differ somewhat from the treatment as outlined by Dr. O'Brien in that we apply x-ray therapy first, then radium, and then, if necessary, a second course of x-ray therapy.

We agree with him that a single modality used to control these lesions is not entirely satisfactory. We use small amounts of radium applied to the lesion over a longer period of time. We have, we believe, been the first in New York to carry out the Regaud method of treatment. We have modified it, to be sure, both in the character of the applicator and in the amount of dosage used. But we still apply the principle that using a small amount of radium over a longer period of time gives a better clinical result. This result has been achieved over the past fifteen years and we feel that it is equally as effective as any other.

Our final result, as Dr. Rosh told you, is about 33 per cent five-year cases alive, well, free of clinical signs of cancer, of about 800 cases treated, which is rather a good result.

We apply x-ray first in our course of treatment because we believe this is most beneficial in reducing infection; shrinking the local tumor; controlling bleeding, and in attacking the cancer in the pelvis along the walls and in cases in which it also extends into the other areas not ordinarily reached by radium therapy.

As Dr. O'Brien properly stated, intensive, excessive amounts of radium do not reach the outlying portions of the involvement but, instead, cause an increased amount of local necrosis with bad results.

We find that in our cases we get good results by using the colpostat with a heavier filter and a larger dose than some men do, but we are not afraid of the larger dose. As

Dr. Rosh reported to you, secondary necroses do not occur with us as often as reported elsewhere. I had the good luck, or, as it were, a better opportunity, to observe some of the work done elsewhere because of my close association in the Cancer Hospital where we admit every case, including even those that Bellevue cannot accept. The Cancer Hospital accepts every case that is sent to us from all outlying hospitals, whether they are voluntary private, proprietary, or municipal hospitals. Thus, we have an opportunity to judge the result and effect in the advanced cases of different types of treatment, and we do not feel that the amount of dosage we have given has created more ill effects than have the smaller dosages given elsewhere.

With the filter and small amount of radium we use, we believe we can better protect the surrounding tissues. We believe, with Regaud, that to be effective the treatment of carcinoma of the cervix must be correctly and intensively given at the first attempt. Repeated treatment does not control as well; usually it causes trouble.

Even in advanced carcinoma cases there is something that can be done. It is always better to have a live patient, free from pain and free from bleeding, with carcinoma that is stationary, than a dead patient in whom we have cured or destroyed all the carcinoma.

Dr. Rosh's paper gives me a great deal of pleasure because Dr. Rosh has been an associate of mine for the past ten years at Bellevue Hospital. She has been intensely interested in the gynecologic service, to such an extent that she now practically controls all cases of carcinoma of the cervix and the methods about which she has spoken.

We feel that if carcinoma of the cervix is treated only by radium or only by x-ray, the best results are not obtained but that the combination of both is necessary.

It is important, too, as Dr. Fricke stressed, to note whether or not infection is present. Dr. Rosh spends a great deal of time painstakingly examining her patients and sometimes defers actual insertion of radium because of the presence of infection. I think that such care counts a great deal as to whether or not the patient will survive treatment and whether the carcinoma can be controlled.

True enough, in the syphilitic cases we have a great deal of difficulty and, as Dr. Fricke said, tuberculous cases probably give as much difficulty. We do not get as many tuberculous cases with cervix lesions as we thought we might because we have a very large tuberculosis service at Bellevue Hospital; but either they die earlier or the clinician on the service thinks it is hardly worth while because they will die anyway. At any rate, we don't get many of them.

But ordinary pathogenic infection is the thing that makes for trouble. It is important, after careful examination of the patient, to see whether the gynecological condition is alone at fault or whether there is a kidney, ureter, or even bladder involvement.

Many times we have been embarrassed by being told that we have had some trouble in the bladder or kidney because of the radium, but it is not the radium. In 99 per cent of the cases, when treatment is properly planned and properly given, the secondary genito-urinary involvement is usually due to disease. One of the common occurrences is blockage of the ureters. If you look for these involvements ahead of time, then you may expect better results.

We have found in some cases that a heavy radium pack sometimes gives better results in the relief of the deep pelvic glands than does x-ray therapy. It is worth trying, and when we have failed with x-ray, we sometimes use the 5-gr. pack with better results.

I have just a little time left, so I will say a word about Dr. Friedman's paper. He has outlined to you an ingenious method of treatment of carcinoma in the body of the uterus. We believe that that method of treatment offers as good a result as surgery in like condition.

Unfortunately, we do not have complete control of operable cases and so these uteri

may be removed. But from the examination of the removed uteri, it can be seen that the radium as applied in this new method suggested by Dr. Friedman does give results and this method is worth while carrying on.

In those cases in which operation is refused or in which operation cannot be carried out, this radium method plus additional x-ray through the pelvis, plus additional x-ray in the vagina will, in many instances, prolong the life of an otherwise hopeless cancer case.

THOMAS R. HEALY, M.D. (Boston): The points have been so well covered that there is hardly anything left to discuss. As the hour is late, I will be brief, but there are one or two salient points I would like to bring out in Dr. O'Brien's paper.

The result of the five-year survival rate is far from satisfactory. Further improvement of this result depends upon early diagnosis and effective radiation directed toward increase of the dose without destruction of the normal structures.

The prognosis is influenced by the clinical stage of the disease, age of patient, and dose of therapy given. As Dr. O'Brien has pointed out, any method of therapy which delivers less than three erythema doses to a point 5 cm. lateral to the cervix will fail to control the disease in the majority of patients whom we now treat. Cross-firing of the parametrium without cross-firing the bladder and rectum is of extreme importance. Increase the dose to the parametria to three erythemas by using the divided dose method through six portals. This is followed by vaginal and intra-uterine radium application and a second roentgen cycle within six months.

The other point brought out by Dr. O'Brien was length of time symptoms existed before the patient sought medical advice. His interval average, if I remember rightly, was about eight months, while my average is 9.7 months. When we study the results of the five-year survival for Group I and for Groups III and IV, we find that the clinical stage of the disease present when treatment is instituted is the most important factor in the prognosis of carcinoma of the cervix.

We must educate the public to the fact that further improvement of these results is dependent upon earlier diagnosis; more frequent pelvic examinations should be made by the family physician who should refer all suspicious cases to the clinic without delay. Prognosis is influenced by increasing the dose to the parametria without destruction of normal structures.

JOHN T. MURPHY, M.D. (Toledo, Ohio): May I ask a question of Dr. Kaplan? I would like him to explain how the 5-gr. pack affects the condition when the x-ray with a greater depth dose will not. I do not have a 5-gr. pack.

DR. KAPLAN: I did not say that it will be better. I say in our hands we get a better result with a 5-gr. pack in some of our cases. Just why, I do not know, but I think there is something biologically selective in its action on the carcinoma.

DR. MURPHY: What is the depth of the 5-gr. pack at 10 cm.?

DR. KAPLAN: It is approximately 12 to 15 per cent in depth.

DR. O'BRIEN (*closing*): I would like to assure Dr. Kaplan that we are now treating cancer of the cervix, whenever we are allowed to, much as he has outlined. We did not give high voltage X-radiation before radium in the work described because, if the surgeon has a patient in the ward, you can realize how uneconomical it seems to tell him the patient must go home for three or four weeks for preliminary x-ray treatment. Since the tumor clinic has been established, we are treating many more cases with high voltage x-rays prior to the administration of radium.

A ROENTGENOLOGIC CONTRIBUTION TO THE PHYSIOLOGY AND ANATOMY OF INTESTINAL MOTILITY[1,2]

A STUDY OF OVER 100 NORMAL INDIVIDUALS

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THE study of the motor functions of the human bowel must be largely based on visualization of the gastro-intestinal tract by roentgen rays. These rays enable us, by means of contrast medium, not only to follow the progress of a meal through the alimentary tract, but also to discover *functional* changes and *anatomic* anomalies and variations which often remain undetected during other clinical examinations. We are able to note to what extent anatomic variations may be responsible for abnormalities in function, a knowledge which may be of particular importance in the clinical study of cases of colon stasis.

We report here the results of what we believe to be the most extensive series of gastro-intestinal roentgen examinations on presumably normal young persons which has yet been undertaken. It includes over 100 young male medical students and 12 women office workers who were apparently in the best of health and had normal bowel habits. Their ages ranged from 20 to 30 years.

These examinations are a basis for the study of the influence of bran on intestinal motility, both in normal individuals (1) and in patients suffering from colon stasis.

Since the emptying time of the bowel of normal individuals varies to some degree, it seemed indicated to repeat the same examination on the same individuals one or more weeks later.

In a group of 50 patients (Group I) we administered a barium suspension, without changing the usual mixed diet, and the emptying of the bowels was studied until the intestinal tract was free from barium (first control test). After two weeks' rest the second control test was run.

In a second group of 76 individuals (Group II) barium suspension was administered as in the first group (first control test), and the second control test was run the following week.

To widen the observation and to visualize all possible physiologic fluctuations, we re-examined 18 subjects of the first group six to eight months later, employing the same procedure applied to individuals of the second group.

We believe that this study gives us a fairly reliable starting point for the development of clinically applicable rules on the roentgenographically recorded gastro-intestinal tract, at least as far as young persons are concerned. A similar series should be undertaken in men and women of older age.

Each series was conducted as follows: the subject was given about 60 to 70 grams of barium sulphate in water suspension in the morning. No preparation of the individuals was made except that they fasted until they had taken the barium suspension. Roentgenograms were taken at three, eight, and 24 hours until the digestive tract was empty. The roentgenograms were made with the subject lying prone (on the abdomen) on a Potter-Bucky horizontal table. The roentgenograms included the abdomen and pelvis, thus giving a complete survey of all parts of the gastro-intestinal tract.

An objection may be raised to the use of barium, namely, that this opaque substance—though quite indifferent to the walls of the gut—may artificially delay the

[1] Accepted for publication in December, 1939.

[2] Assisted by a grant from the Kellogg Company, Battle Creek, Michigan.

progress of the contrast meal. Indeed, it cannot be denied that some individuals have spoken of "hardness" of stools or "getting constipated" after taking barium. To lessen this objection, we diminished the quantity of barium to 25 to 30 grams per subject in one group of our series, and found the rate of output practically the same as in the other cases. A. E. Barclay (2) also found in his experiments in which charcoal was combined with opaque meals that the latter had no definite action in the intestine and that the occasionally reported abnormalities of emptying were "probably due not to the action of the opaque food but to the psychic effect of the unusual meal."

In some cases fluoroscopy of the intestines was indicated, particularly when the study of the roentgenograms did not reveal all necessary details of a particular anatomic condition.

A study of evacuation of the intestines must include a consideration of the emptying of the stomach, because clinical experience has shown that the two may be related to each other also under normal circumstances. Thus, for instance, in cases of decreased gastric acidity, the emptying not only of the gastric contents but of those of the bowel may be markedly accelerated; and, on the contrary, a great many individuals with increased acidity show delayed emptying of the stomach and consequently a slow or supposedly delayed emptying of the bowels.

In regard to this relation, our study has not shown anything of importance. There was not one case in which a change in the emptying time of the stomach (within its physiologic limits) resulted in a remarkable change of intestinal motility, and even differences of two or three hours in the emptying of the stomach did not result in a change of intestinal motility which could be interpreted as a consequence.

The first roentgenogram, taken three hours after the contrast meal, enables us to visualize the emptying of the stomach in its last phase, and at the same time reveals the emptying of the small intestines at its culmination.

The films taken eight hours after the meal usually showed, provided conditions were normal, both the stomach and the small intestines to be empty. This roentgenogram thus significantly reveals any marked change in the emptying of both organs. Furthermore, it enables us to observe the degree of subsequent filling and emptying of the cecum and ascending colon.

Having dealt with normal individuals throughout, we had no opportunity to observe a markedly changed emptying of the small intestines. Thus, we had no opportunity to record the possible influence of a changed motor function of the small intestines on the large bowel. None of the 126 individuals who were examined revealed any marked deviation from the average and widely known figures concerning the emptying time of small intestines; nor did we meet any anatomic variations in this region, the observation of which could have been used for a better knowledge of small intestinal motility.

Cecal Evacuation.—The 24-hour films present the first general view of the barium-opaque contents in the colon. As far as their distribution and the emptying time of the large bowel is concerned, there are two findings which deserve special attention—the cecal and total emptying times. The length of time between the actual introduction of barium and the emptying of the cecum is called the "cecal emptying time." That period which first showed the entire gastro-intestinal tract empty is designated the "total emptying time." These two periods seem to us to be a kind of cornerstone in the proper evaluation of the emptying of the colon; and their registration is the basis of our subsequent examinations.

Unfortunately, there is still disagreement among physiologists, roentgenologists, and clinicians as to what is meant by normal emptying of the intestines. Unquestionably the emptying of the colon is a complex matter which includes variations of the cecal and total emptying times, peristaltic conditions, the tonus, occasionally also anatomic items, with an apparently unlimited

interchange of all these factors. Roentgen rays not only reveal the exact location and extent of the opaque meal in the colon but they also give, in particular, instructive and detailed information as to the tonus and the peristaltic action which can hardly be studied in any other clinical way.

As far as the emptying time as a leading criterion of the motor function is concerned, it was discovered in the literature that there does not exist a generally accepted or verified opinion as to the exact time relations of the passage of the contrast meal through the normal gastro-intestinal tract. Our observations, which are based on the comparatively large group of 126 normal individuals, permit conclusions which may be of both theoretical and practical interest.

Table I gives a survey of the cecal emptying time of 126 individuals. It reveals that in 92.06 and 88.09 per cent, respectively (first and second group), the emptying of the cecum occurs within 24 hours. In from 7.92 to 11.9 per cent of the control tests, we found an emptying time within 48 hours. We did not meet even one normal individual who showed a cecal emptying time exceeding 48 hours. Thus, we are justified in stating that, while a *cecal emptying time of 24 or even 48 hours might be considered normal, a 72-hour emptying time is a sign of a pathologically delayed motility.* The comparatively rather frequent occurrence of 48-hour cecal emptying time might be surprising. It seems to be somewhat contradictory to the much lower figures presented in the literature. These figures are based on the timing of the head of the barium column, while we time the tail. The figures based on the former method of x-ray interpretation of the colon emptying time are misleading from our point of view and indicate indirectly the speed of the movement but do not reveal whether stasis exists, as do the figures in our tables.

TABLE I.—CECAL EMPTYING TIME

126 Individuals

Emptying Time (in hours)	Barium Test: First Control No. Cases	Percentage	Second Control No. Cases	Percentage
24	116	92.06	111	88.09
48	10	7.92	15	11.9
72	...	...	...	...
Total	126		126	

As far as the dependable interpretation of remnants and traces in any section of the colon are concerned, it may be remembered that *isolated spots or even more extended but thin layers must not be considered as a sign of pathologic stasis.* These opacities are found either as a partial consequence of antiperistalsis which is rather frequent in the cecum and ascending colon, or they are the result of an increased inspissation in the proximal colon which makes the barium-containing stool more contrast-giving. Besides, after an apparently almost complete evacuation, one often sees irregularly distributed small remnants of barium in different colon sections without being indicative of an altered motor function. In other words, the visualization of small residues does not justify the claim of an even slight degree of retention. Retention means not only a delayed propulsion of the colon contents but it requires changes, affecting both the anatomy of the respective colon section and the motor function of the whole colon.

Fourteen individuals out of the 126 showed a marked fluctuation of the cecal emptying time in the two control tests. Six of these 14 showed an emptying time of 48 hours in the first control test, while the second control test revealed an emptying of 24 hours. The other eight cases of this group had a cecal emptying of 24 hours in the first and a 48-hour emptying in the second control test of this series. In none of them, therefore, was the emptying time (48 hours) constantly present. Significantly enough, three out of the 18 individuals who were re-examined after a period of from four to eight months showed also a varying cecal emptying time of from 24 to 48 hours.

The figures in Table II reveal a wide variation of the *total* emptying time in normal individuals and the figures which refer to the emptying in 96 (13.49 and 16.66 per cent) and 120 (3.96 per cent)

hours are of particular interest. These high figures verify in principle the results of the experiments of Alvarez and Friedlander (3), who studied the rates of progress of 50 small glass beads given to normal individuals and found an average percentage as follows: 15 per cent were passed at the end of the first day, 40 per cent on the second day, 15 per cent on the third day, and from 5 to 10 per cent on the fourth and fifth days of the observation. The much lower figures in textbooks of physiology, medicine, and roentgenology are apparently due to a lack of a sufficient number of normal individuals who could have been examined thoroughly for such purposes and to the omission of second control tests made on the same individual, a procedure which seems to us indispensable because of the wide variations.

The high degree of fluctuation under physiologic conditions is revealed by the emptying times of those normal individuals who were examined at two different time intervals. The comparison shows, in some cases, differences up to 48 hours after an interval of from four to eight months, although it was ascertained that the patients had not changed their diet and living conditions at all.

Particular attention should be paid to the figures of Table III which gives a survey of cases with a 48-hour *cecal emptying time in relation to their total emptying time.* It shows that this comparatively slow cecal emptying time does not necessarily cause a subsequent delay of the total emptying time. As far as this possible relationship of cecal and total emptying time is concerned, there is another group of cases which has shown different cecal emptying time in both control series (24 and 48 hours), mentioned in the preceding paragraphs. All these surveys indicate that there is no closed relationship between the cecal and total emptying time, at least as far as the rough motor function is concerned.

TABLE II.—TOTAL EMPTYING TIME

126 Individuals

	Barium Test			
Emptying Time (in hours)	First Control No. Cases	Per-centage	Second Control No. Cases	Per-centage
24	1	0.79	1	0.79
48	36	28.57	36	28.57
72	67	53.17	62	49.20
96	17	13.49	21	16.66
120	5	3.96	5	3.96
			(1 exam. missing)	
Total	126		126	

Anatomic Studies.—A roentgenologic study of the intestinal motility should include a discussion of the anomalies and variations of the colon which one meets so frequently. The advantage of a roentgenologic consideration of the anatomy of the colon goes far beyond a descriptive statement of items concerning the location, size, and outlines of the different colon sections. "The domain of the radiologists is the study of the *living* human being," says A. E. Barclay. Certainly the study of the emptying of the colon is a particularly instructive example of the correctness of this statement. The posture of the subject, the mobility of a colon section, the condition of the tonus, the wide scale of the peristaltic actions, and the influence of respiration—all these influences on the motor function of the colon cannot be studied dependably without roentgen rays.

The greatest variations which we encounter predominantly concern the cecum and the transverse colon. As far as the cecum is concerned, there is a wide range of variations and anomalies, most of which are undoubtedly of congenital origin. Above all there is the failure of rotation of the cecum which may result in a series of characteristic anomalies. Connell (4) shows

TABLE III.—RELATION BETWEEN CECAL EMPTYING TIME AND TOTAL EMPTYING TIME IN CASES WITH SLOW (48 HOURS) CECAL EVACUATION IN BOTH CONTROLS

	First Control		Second Control	
Case No.	Cecal Emptying Time (in hours)	Total Emptying Time (in hours)	Cecal Emptying Time (in hours)	Total Emptying Time (in hours)
8	48	72	48	96
15	48	72	48	72
22	48	72	48	72
25	48	72	48	48
65	48	72	48	48
66	48	120	48	96
130	48	72	48	72

that the "rotation of the cecum" comprises three distinct elements. They are: migration, rotation, and fixation. Migration, as Connell pointed out, may be incomplete or delayed; it may become arrested at any point between the hepatic flexure and the "normal" position of the cecum in the right iliac fossa. The latter, however, varies also according to the constitutional type of the subjects. In the event of a striking arrest of the developmental migration, we encounter a highly placed or undescended cecum which may be lying directly under the surface of the liver.

Other anomalies occur when the terminal ileum enters the cecum from behind, from the right side, or, much less frequently, from the front.

The cecum located extremely low in the pelvis, called "pelvic cecum," is usually associated with a markedly lengthened ascending colon. A lengthening of the ascending colon, however, is also found occasionally associated with a hepatic flexure which is displaced upward behind the liver.

We found these variations of the cecum in eight out of our 126 normal individuals. They were of different degree. In general, all these cases revealed normal emptying conditions and it might be of particular interest to note that we recorded a 48-hour cecum emptying time in but one case, while the seven others of this group showed a cecal emptying time of 24 hours. Thus it is evident that even cases with exceedingly marked pelvic cecum, do not necessarily show delayed emptying in normal individuals.

Absence of the normal fixation of the cecum results in the much discussed "cecum mobile," a term first introduced by T. Hausmann (5). According to the numerous reports in the literature, the cecum mobile may be associated with colicky pains in the right abdomen and with constipation. The pains are said to be caused by a more or less marked volvulus due to the abnormally long mesenterium. While we admit that the knowledge and recognition of this variation is not without value for surgery, we must refer to the fact that we found a well marked cecum mobile, in five out of 126 normal individuals yet none of these individuals revealed a change of the cecal or total emptying time or any other noticeable alteration of the emptying conditions. Béclère and Mériel (6) were also of the opinion that a cecum mobile is compatible with normal health and is not necessarily pathologic.

The variations of the transverse colon are very numerous, due to its varying length and the length of the transverse mesocolon. The latter becomes evident by comparison of the different positions of the transverse colon as revealed in the upright posture and upon lying down. The varying positions of the transverse colon deserve special attention with regard to the much discussed coloptosis. It is false to label any transverse colon as ptosis just because its middle portion hangs down deep into the pelvis. Such a position of the transverse colon occurs frequently in individuals in perfect health. Indeed, we encountered such a ptosis in 21 out of 126 individuals who had normal bowel habits. We may add that, according to the above mentioned conditions, this comparatively low position of the transverse colon varies markedly and repeatedly on successive days in the serial examinations of the same individual. The term "coloptosis" must be restricted to cases in which not only the transverse colon but also both flexures appear markedly displaced downward, in other words, in cases which show a ptosis of the *entire* colon.

As far as the cecal and total emptying time in individuals with ptosis of the transverse colon are concerned, we could not find any conclusive or even indicative figures which might mean a definite influence on the emptying. While in some cases we found both the cecal and total emptying time comparatively (but not pathologically) prolonged, we must state that the greater percentage of them possessed the average emptying time of normal individuals and did not show any signs of colon stasis at all.

As far as the frequently mentioned

angulations and reduplications at one or both flexures are concerned, it appears that their functional and clinical importance is overrated. They are chiefly the result of a marked ptosis of the transverse colon and its decreased tonus. These provide free mobility of the adjacent colon sections and may be detected by careful palpation under fluoroscopy. Sharp angulations may occasionally be due to actual kinking; "more often," as Carman (7) pointed out, "it will be found that this appearance is due to the angle at which the loop is viewed."

One of the most frequently observed anomalies of the distal colon is the redundancy of the sigmoid colon. It is congenital and consequently is hardly to be considered secondary to functional change. J. W. Larimore (8) found that the frequency of its occurrence in newborns is similar to that in adults. The degree of these redundancies varies greatly and, in less marked cases, the term "elongated sigmoid colon" seems preferable. While we found this variation in normal individuals without any signs of impairment of the motor function of the colon, we must admit that combined with a marked dilatation (which may be due to an associated atony) it might be an aggravating factor leading to the development of colon stasis. In addition, it should be noted that the loop of the elongated sigmoid colon is rather frequently seen under normal conditions in the right lower abdomen, close to the cecum, imitating a contact which is, as a rule, temporary and depends chiefly on the degree of filling of the sigmoid colon.

In conclusion, we may emphasize that in normal individuals there is no evidence of a definite relationship between the aforementioned anomalies or variations and the motor function of the colon. "Abnormalities do not, of themselves, produce symptoms but lead to mistakes in diagnosis," said von Bergmann. In the light of our studies we agree thoroughly with this statement.

All these observations were made exclusively on young healthy individuals who had normal bowel habits. The results, as pointed out, are primarily of physiologic interest. The knowledge of these items may prevent the overrating of their rôle in cases in which the presence of certain abdominal complaints would justify the assumption of a causative relationship. As far as the occurrence of variations in constipated patients is concerned, we do not deny the possibility that they may lay the foundation for certain types of colon stasis in later years. Our serial examinations on constipated patients, which is still running on a large scale, will be devoted to the question.

I wish to express my thanks to Dr. Bernard M. Fantus, for his helpful suggestions and criticisms; to Dr. Adolph Hartung, for his kindly interest; to Dr. H. Schmidt, for his assistance, and to William Tinsley, technician.

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A NEW ORGANIC THORIUM COMPOUND FOR X-RAY DIAGNOSTIC PURPOSES[1]

A PRELIMINARY REPORT

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From the Research Laboratories of the National Drug Company

ACCORDING to Hull's law (1) the radiopacity of a substance is in direct proportion to the third power of the atomic weight. It is for this reason that whenever radiopaque substances are employed only substances of high atomic weight are used, such as iodine, barium, bismuth, etc. A number of other elements with high atomic weights also have radiopacity, but another important requirement is that the substance must be of low toxicity for biological or medical application.

Thorium is an element with a very high atomic weight (232.12) and it is obvious, therefore, that it possesses a very high degree of radiopacity. In general, the toxicity of thorium compounds is low. In spite of this, however, thorium compounds have not been extensively used as a diagnostic medium because they possess a very undesirable property, namely, all thorium compounds possess radio-activity.

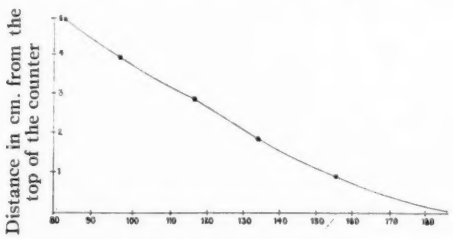
One of the thorium compounds is a colloidal suspension of thorium dioxide. This preparation gives excellent x-ray films but has been shown to possess radio-activity, 25 c.c. being equivalent to 1 microgram of radium. The beta rays are negligible. Gamma rays emanated from 25 c.c. of this preparation are equivalent to 0.4 microgram of radium.

Following intravenous injection of thorium dioxide, thorium is taken up over a period of several days by the cells of the reticulo-endothelial system, in the liver, spleen, lymphoid tissue, and bone marrow and, to a lesser extent, by the ovary and suprarenal.

It appears that this absorption of the thorium is due mainly to the colloidal nature of the solution.

We felt that a compound of thorium, preferably an organic salt, which would give a true solution in water, might perhaps not be so readily deposited in the reticulo-endothelial system. A number of organic compounds of thorium were prepared, such as sodium thorium citrate, thorium gluconate, thorium acetate, and sodium thorium tartrate. From preliminary tests the most promising of all these organic thorium compounds seemed to be sodium thorium tartrate. In this report we shall, therefore, restrict ourselves to that preparation.

Sodium thorium tartrate was prepared as follows: Forty-eight grams of thorium nitrate were dissolved in 100 c.c. of water; 67.2 grams of tartaric acid were dissolved in 100 c.c. of water. The tartaric acid solution was added to the thorium nitrate solution and 300 c.c. of denatured alcohol was then added, the thorium tartrate being precipitated from the solution as a gelatinous mass. This was filtered off, washed with denatured alcohol, and dried, yielding about 50 grams of insoluble thorium tartrate. To the thorium tartrate, suspended



This chart shows how the counts vary with the distance.

Repeated on three different days, the results were — 191
234
190

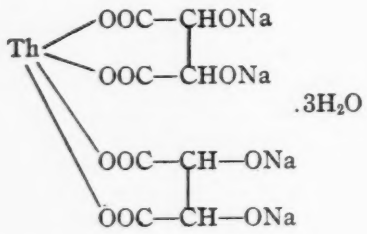
Average— 205 counts per minute at 0 cm.

Chart I. Counting rate.

[1] Read before the Medicinal Division, American Chemical Society, in Baltimore, April 3–7, 1939.

in 100 c.c. of distilled water, was added 10.8 grams of C.P. sodium hydroxide, dissolved in 10 c.c. of water. Heating facilitated the ease of solution of the thorium tartrate and speeded the chemical reaction. The solution was filtered and precipitated with alcohol-acetone mixture. The precipitate was dried and yielded 53 grams of sodium thorium tartrate.

The analytic study seems to show that the sodium thorium tartrate has the following formula:



Molecular weight 670.18

Thorium content	34.63 per cent
Sodium content	13.72 per cent
Water content	8.06 per cent
Tartaric acid	43.57 per cent

From this it would seem that the compound we have obtained is a *tetra* sodium *mono* thorium olitartrate of a molecular weight of 670.18. It has a theoretical thorium content of 34.63 per cent: this was found by analysis to be 36.5 per cent. The sodium content by analysis was found to be 12.84 per cent: the theoretical value is 13.72 per cent. The theoretical value for tartaric acid is 43.57 per cent: the assay value was 46.0 per cent.

Sodium thorium tartrate is a white powder, very soluble in water but insoluble in organic solvents.

The radio-activity of thorium nitrate, of mesothorium, and sodium thorium tartrate was determined by means of a sensitive photographic film.[2] It was found that mesothorium is strongly radio-active; thorium nitrate and sodium thorium tartrate possess a weak but definite radio-activity. A 5 per cent solution of thorium gluconate showed a very weak activity.

After further study the thought occurred to us of using high molecular solutions, such as sugars or gelatin, etc., of a colloidal nature to dissolve the sodium thorium tartrate. The following results were found by the sensitive photographic film method with a 5 per cent solution of sodium thorium tartrate:

In 50 per cent sucrose there is no radio-activity;

In 20 per cent sucrose a weak radio-activity;

In 25 per cent glucose a weak radio-activity;

In 50 per cent glucose extremely weak radio-activity;

In 1.5 per cent gelatin solution weak radio-activity;

In 25 and 50 per cent cerelose weak radio-activity.

In order to check this, these solutions were tested on a Linde electroscope and it was found, in a qualitative way, that the powder of thorium nitrate and of sodium thorium tartrate affected the rate of discharge of the gold leaves considerably, while the 10 and 25 per cent solutions of sodium thorium tartrate in 50 per cent sucrose and in 50 per cent glucose showed no change in the normal discharge. The aqueous solution of sodium thorium tartrate as well as the 0.5 per cent gelatin solution of sodium thorium tartrate showed a slight increase over the normal discharge, thus indicating the presence of only a small amount of radio-activity.

In order to check more accurately whether the 50 per cent sucrose or 50 per cent dextrose solutions actually screen out some of the radio-active rays, these thorium compounds and various solutions thereof were tested with the Geiger-Mueller Counter.

The Geiger-Mueller Counter is a very sensitive instrument which enables one to detect the presence of minute amounts of gamma rays. The Geiger-Mueller Counter,

[2] This testing was done by Professor A. Bachem, University of Illinois Medical School, Chicago, Illinois, to whom we are greatly indebted.

constructed by Dr. D. P. Le Galley,[3] gave quantitative measurements as well as clearly showing the presence of minute amounts of gamma rays in our sodium thorium tartrate in solid form as well as in aqueous 25 per cent solution and in the 25 per cent solutions containing 50 per cent sucrose, 50 per cent dextrose, and 0.5 per cent gelatin.

In order to get more precise results, the Geiger-Mueller Counter would have to be equipped with an automatic counting device which would permit readings to be taken over a long period of time and thus cut down on the percentage of error.

TABLE I

Solution	Net Count per Minute
Colloidal thorium dioxide 25 per cent aqueous	60.7 ± 2.2
Sodium thorium tartrate 10 per cent aqueous	18.5 ± 0.7
Sodium thorium tartrate 25 per cent aqueous	36.1 ± 1.5
Sodium thorium tartrate 25 + 50 per cent dextrose	31.8 ± 0.9
Sodium thorium tartrate 25 + 0.5 per cent gelatin	37.0 ± 1.4
Sodium thorium tartrate 25 + 50 per cent sucrose	34.7 ± 1.4

The net count in Table I is obtained by subtracting from the total number of counts the residual count. The residual count measures the number of counts obtained with the Geiger-Mueller Counter due to cosmic rays and other disturbances at random.

These results demonstrate that the radio-activity due to the gamma rays is not as high in sodium thorium tartrate 25 per cent solution as in the 25 per cent thorium dioxide solution. Of course, it is true that the amount of thorium in the thorium dioxide is greater than in our sodium thorium tartrate.

It is interesting to point out that with an instrument as accurate as the Geiger-Mueller Counter a differentiation was obtained between the values for the aqueous solution of 25 per cent sodium thorium tartrate and the 25 per cent solution of sodium thorium tartrate in 50 per cent dextrose and in 50 per cent sucrose. It seems, as we have pointed out before, that a certain screening action or absorption effect of the gamma rays is obtained by the use of the 50 per cent sucrose or dextrose.

[3] Professor of Physics, at the Philadelphia College of Pharmacy and Science, to whom we are deeply indebted.

TABLE II.—COMPARISON OF SAMPLES AGAINST STANDARD MICROGRAM OF RADIUM (N.B.S.)

Samples	Counts	Standard	Actual Amount of Radium Present
Colloidal thorium dioxide 25 per cent aqueous	60.7	205	0.296 microgram
Sodium thorium tartrate 25 per cent in aqueous solution	36.2	205	0.176 "
Sodium thorium tartrate 25 per cent, 50 per cent dextrose	32.6	205	0.159 "
Sodium thorium tartrate 25 per cent, 0.5 per cent gelatin	37.6	205	0.183 "
Sodium thorium tartrate 25 per cent, 50 per cent sucrose	35.5	205	0.173 "

In order to arrive at a more accurate quantitative result of the radio-activity obtained with the various thorium compounds, a microgram of radium was secured from the National Bureau of Standards.

Placing the microgram of radium (standard sample) on top of the counter 0 cm. from it gave a reading of 190 counts. If the microgram of radium is placed at varying distances, naturally the counts will diminish as the distance increases. (See Chart, page 45.)

It should be noted that the American Medical Association, in a report of the Council on Pharmacy and Chemistry (2) states that colloidal thorium dioxide gives a value of 0.3 to 0.4 microgram of radium which checks with 0.296 given above. While colloidal thorium dioxide is equivalent to 1/3 microgram of radium, the sodium thorium tartrate is equal approximately in radio-active properties to 1/6 of a microgram.

The results obtained in Table I show that there are distinct differences between the count readings of sodium thorium tar-

trate 25 per cent in the various buffer solutions such as 50 per cent dextrose, 50 per cent sucrose, or 0.5 per cent gelatin. However, these differences may perhaps be accounted for by the thickness of the glass ampul, the geometric position of the ampul and the counter, and the tilting of the liquid in the ampul may affect the reading slightly.

TABLE III

Liquid	First Series	Second Series	Averages
Water	84.4	82.3	83.3
Dextrose 50 per cent	79.9	78.8	79.3
0.5 per cent gelatin	82.2	82.7	82.5
Sucrose 50 per cent	77.9	76.7	77.3

Liquid	Absorption Counting Total minus Residual = Actual Count	Emission Counting
Water	83.3 − 14 = 69.3 ± 1.3	36.2
Dextrose 50 per cent	79.3 − 14 = 65.3 ± 1.4	32.6
0.5 per cent gelatin	82.5 − 14 = 68.5 ± 1.1	37.6
Sucrose 50 per cent	77.3 − 14 = 63.3 ± 1.1	35.5

In order to study these factors a microgram of radium and radon and beryllium was placed on top of the jars filled with the liquid. The glass jars of 20 cm. depth were filled with liquid almost to the top. All four liquids, distilled water, 50 per cent sucrose, 50 per cent dextrose, and 0.5 per cent gelatin, had a residual counting rate of 14 per minute. This indicates a slight absorption of cosmic rays, from 16.3 to 14, by the 20 cm. of liquid, as might be expected.

A series of 20 readings on one day and another 20 readings on another day yielded the results shown in Table III.

It can be seen from this table that high concentrated sugar solutions such as 50 per cent sucrose and 50 per cent dextrose seem to possess a certain screening action which can be seen by the lower figure of the absorption counting and the emission counting.

The x-ray absorbing ability of a series of samples was tested by means of an x-ray film, the distance of the x-ray tube to the film being 70 cm. and the spark gap 14 cm. If barium sulphate was arbitrarily assumed to have an x-ray absorbing power of 10, then the following results (Table IV) were obtained:

TABLE IV

Barium sulphate	10
Thorium dioxide colloidal	9
Sodium thorium tartrate 25 per cent–dextrose 50 per cent	7
Sodium thorium tartrate 25 per cent–0.5 per cent gelatin	7
Sodium thorium tartrate 25 per cent–50 per cent sucrose	6
Sodium thorium tartrate 25 per cent aqueous solution	5
Sodium thorium tartrate 10 per cent–0.5 per cent gelatin	1

These results indicate that there is a considerable amount of radiopacity in the 25 per cent sodium thorium tartrate solutions, and that the presence of the sugars or gelatin seems to increase the radiopacity.

ANIMAL EXPERIMENTS

Two rabbits received 1 c.c. doses of 25 per cent sodium thorium tartrate in 50 per cent sucrose daily for a period of 30 days.

Two rabbits received 10 c.c. doses at weekly intervals for three weeks so that all four rabbits received 30 c.c. of the thorium compound. Blood counts were run on normal rabbits, on blood from the heart and ear of each rabbit, for four consecutive days before any doses of the compound were given. The results showed that the daily administration of 1 c.c. of sodium thorium tartrate 25 per cent to rabbits for a period of 30 days did not change the blood picture, the red cells and the white cells remaining unchanged. The same was true for the rabbits that received the thorium compound in 10 c.c. doses orally at weekly intervals for three weeks. No change in the red and white blood cells was observed. After 30 days of oral ingestion of the thorium compound the rabbits showed no ill effects.

These rabbits were then roentgenographed and the x-ray films, upon very close examination, showed no change in the structure of the skeleton and bones.

It seems to us, therefore, that a 30-day oral administration of sodium thorium tartrate has in no way had an injurious effect upon the bone tissues such as might possibly be undoubtedly due to the rapid elimination that no effect of the minute amount of radio-active substance present has made itself evident in the bone structure of the

TABLE V

Empty Box	Rabbit No. 9, Normal	Rabbit No. 9, Normal, Repeated	Bone and Tissue of Rabbit Treated for 60 Days	Rabbit No. 402, 10 c.c. Dose Weekly for 60 Days	Rabbit No. 402, Repeated	Rabbit A381, 10 c.c. Dose Weekly for 60 Days	Rabbit No. 10, 1 c.c. Dose Daily for 60 Days	Rabbit No. 4, One 20 c.c. Dose
22	18	19	17	32	22	20	21	23
23	26	18	17	31	20	28	24	27
24	17	16	20	28	18	34	25	19
18	20	23	28	30	28	23	21	22
16	21	20	21		25	21	24	28
22		18	24			22		
15			25					
18								
Average								
20	20	19	22	30	22.5	24.6	23	24

due to the destructive action of the minute radio-activity present in the thorium compound. The rabbits were also examined under the fluoroscope with the idea in mind to notice any fluorescence or luminescence caused by a possible deposit of radio-active material in the bone tissue or bone structure. A very thorough examination under the fluoroscopic screen did not disclose any trace of fluorescence or luminescence.

The same rabbits were subjected for an additional 30 days to ingestion of the 25 per cent sodium thorium tartrate. The rabbits that received 1 c.c. were given 1 c.c. orally for another 30-day period. The rabbits that received 10 c.c. orally every week for three weeks were continued on treatment for another 30-day period.

Again the blood picture of these rabbits did not change. The rabbits were in excellent condition.

The same rabbits were again roentgenographed and they still did not show any signs of change in the bone tissues or structure. Also, upon examination under a fluoroscopic screen no luminescence or fluorescence was noticed. This appears to demonstrate clearly that the sodium thorium compound ingested orally for 60 days by rabbits is eliminated rapidly enough so as not to cause a cumulative effect. It is rabbit, which seems to make sodium thorium tartrate suitable for diagnostic gastro-intestinal work.

In order to study the radiopacity of our sodium thorium tartrate one control rabbit received 75 grains of barium sulphate in 20 c.c. of water, by stomach tube, and an x-ray film was made at once. The rabbit showed a distinct outline of the stomach, particularly of its lower curvature, where apparently the barium sulphate had settled, due to the gravity of the barium. No folds could be discerned. The rabbit receiving 10 c.c. of 25 per cent sodium thorium tartrate showed a distinct outline of the stomach with the rugæ distinctly discernible. The density of the shadow, however, was not as great as the one obtained with the barium sulphate. It was for this reason that another rabbit received 20 c.c. of the 20 per cent sodium thorium tartrate. This resulted in a very clear and distinct outline of the entire stomach, upper and lower curvatures, and also disclosed the rugæ of the stomach. Additional studies along this line and further animal experimentation are in progress.

Four rabbits were tested by means of the Geiger-Mueller Counter for the presence or absence of gamma rays due to deposited or absorbed thorium (Table V).

These experiments showed that the normal count of the empty box used to hold the rabbits was an average value of 20 according to the Geiger-Mueller Counter. A normal rabbit placed in this box gave a count of average 19. A jar containing tissues from a rabbit which had been treated daily for 60 days with 1 c.c. of 25 per cent sodium thorium tartrate and died from an infection, gave a count of 22.

Two rabbits treated with 10 c.c. of 25 per cent sodium thorium tartrate orally per week for a period of six weeks gave a count of 23.

Rabbit No. 4 had received orally a dose of 20 c.c. of 25 per cent thorium sodium tartrate in 50 per cent sucrose shortly before being placed in contact with the Geiger-Mueller Counter and gave a count of 24.

These results indicate that after the oral administration of 25 per cent sodium thorium tartrate in rabbits for a period of 60 days or more, most of the thorium compound is eliminated and no cumulative effect occurs. Studies are under way concerning the manner and rate of elimination. While, according to the Geiger-Mueller counts, there is a very slight increase in the number of counts over the normal animal, this increase is so small as to be considered physiologically negligible. This radio-activity is so minute that even x-ray films or the fluoroscopic screen is unable to detect it.

Pathologic studies of tissues are being made at this time to determine if there is a deposit or retention in any of the organs, or radio-active substance from the thorium, following intravenous administration.

SUMMARY

1. Theoretical considerations of a physical chemical nature are offered which led to the selection of an organic thorium compound as a diagnostic agent, particularly for the gastro-intestinal tract.

2. The preparation of sodium thorium tartrate is outlined and supported with analytical figures. A possible structural formula of this compound is suggested.

3. Attempts to determine the radioactivity of this and other thorium compounds by the sensitive photographic film method, by the Linde Electroscope, and by the Geiger-Mueller Counter are described.

4. It seems that high molecular solutions such as sugars, 50 per cent sucrose, or 50 per cent dextrose screen out to some extent the gamma-ray activity of the radioactive thorium compounds. Absorption and emission counts are determined and differences in the absorption action for dextrose, sucrose, and gelatin are noted.

5. The radiopacity of the sodium thorium tartrate is determined by means of highly sensitive x-ray film.

6. Experiments on rabbits showed a complete lack of toxicity if sodium thorium tartrate is given per stomach over a period of more than 60 days.

7. Rabbits thus treated with sodium thorium tartrate did not show any changes in the bone tissues or bone structure. The ingested sodium thorium tartrate did not possess cumulative action when administered by stomach and it seemed to be rapidly eliminated.

8. Rabbits that received 10 c.c. and 20 c.c. of the sodium thorium tartrate orally and whose x-ray films had been made at once showed a clear, distinct outline of the upper and lower curvatures of the stomach including the rugæ. The x-ray film, thus obtained, particularly after the 20-c.c. dose, is superior to the x-ray film obtained with barium sulphate.

The authors express their appreciation to Miss Catherine E. Aye, of the Biological Laboratories of the National Drug Company, who conducted the animal experiments. They also wish to thank Dr. Claude P. Brown, Director of the Biological Laboratories of the National Drug Company, for his assistance and advice.

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NUCLEAR PHYSICS AND THERAPY: PRELIMINARY REPORT ON A NEW METHOD FOR THE TREATMENT OF LEUKEMIA AND POLYCYTHEMIA[1]

By JOHN H. LAWRENCE, M.D., *Berkeley, California*

From the William H. Crocker Radiation Laboratory, and Department of Medicine, University of California

BECAUSE of the discoveries and developments in the field of nuclear physics during the past few years, artificial radio-activity is available in nearly all of the chemical elements. Although these new radio-active isotopes give off rays (beta rays, gamma rays, positrons, etc.) similar to those emitted by *radium*, they differ markedly from radium in several respects. In the first place, each radio-active isotope maintains the chemical characteristics of its naturally occurring inactive relative. For instance, radio-sodium, radio-phosphorus, radio-iron, etc., have the same appearances and the same chemical reactions as do the inactive relatives of these isotopes. They are distinguished only by the rays they emit, which can be detected by means of Geiger counters or electroscopes. Therefore, when these elements are fed to or injected into the animal body, they are handled like ordinary sodium, phosphorus, or iron. When, however, strong activities of these isotopes are administered, the radiation causes biologic changes similar to those following x-ray or radium irradiation. Secondly, the so-called "half lives" of the artificially radio-active substances are very short compared with the "half life" of radium. The activity of radium decreases to one-half after a period of 1,550 years, while the half life of sodium is 14.8 hours, of phosphorus 14.3 days, and of iron 47 days. For therapy, therefore, artificial radio-activity may be used in two major ways: first, as a substitute for radium or radon in seeds, capsules, or bombs for direct application to the diseased area over certain periods of time; and second, certain radio-active elements administered by mouth or by injection may localize in certain areas which are to be irradiated. Examples are the localization of iodine in the thyroid gland, of iron in the red blood cells, and of phosphorus in bone. The purpose of this paper is to enlarge on some of these possibilities, and to summarize briefly some of the experimental and clinical work which has been done. A more appropriate title for this article might be, "What does artificial radio-activity offer for therapy?"

1. *The Use of Radio-active Isotopes as Tracers.*—When artificial radio-activity was discovered, its obvious value in the study of physiologic processes was recognized immediately. Numerous investigators throughout the world are now using artificially radio-active isotopes as aids in the study of the absorption, distribution, and excretion of the various elements in normal and abnormal processes, both in animals and in man. The radiations really "label" the element and the presence of a fraction of a given dose of any element, deposited in tissue or biologic materials, may be determined accurately by counting the radiations emitted by that tissue. The work with radio-active iron perhaps best exemplifies this application. Hahn, Bale, Whipple, *et al.*, studied the absorption, transportation, utilization, and excretion of iron in normal and anemic dogs after administration of labelled or radio-active iron in the form of various iron compounds (1, 2). They found that in the normal dog iron is absorbed in negligible amounts when there is no need for it, whereas in the anemic animal, iron is promptly assimilated. They also found that "plasma is clearly the means of transport of iron from the gastro-intestinal

[1] Based on a paper presented as part of the symposium, "Nuclear Physics in the Service of Medicine," at the Twenty-fifth Annual Meeting of the Radiological Society of North America, at Atlanta, Dec. 13, 1939.

tract to its point of mobilization for fabrication into hemoglobin." These investigators showed conclusively that the dog "controls its iron stores by absorption or lack of it rather than by its capacity to eliminate iron and that this animal excretes iron with difficulty and in small amounts by means of the biliary and gastro-intestinal tracts." Similar studies on phosphorus metabolism have been carried out in which the radio-active isotope was used as a "label." As compared with iron, phosphorus is nearly completely absorbed by the gastro-intestinal tract and is excreted slowly. In studies on animal and human leukemia (3, 4) it has been found that leukemic tissue has greater uptake and exchange of phosphorus than normal tissues have, although the total phosphorus content of leukemic tissue does not differ from normal. Since leukemic tissue, bone, and bone marrow take up a relatively high concentration of phosphorus and since beta rays are emitted by radiophosphorus, it was suggested that radiophosphorus might prove to be of value in the treatment of leukemia. Therapeutic attempts in the treatment of leukemia will be discussed later in this paper. These findings perhaps indicate how the use of radio-active isotopes as tracers may lead to their application in therapy. Another example of the localization of an element in specific tissue is demonstrated by the work of Hamilton and Soley[2] (5), who are using radio-iodine in the study of thyroid metabolism. They have shown that *iodine* is concentrated in the thyroid gland, and their work suggests the use of this isotope orally or parenterally in the treatment by irradiation of certain diseases involving this gland.

Since it is known that certain dyes are selectively absorbed by certain tissues, it is hoped that someone will be able to incorporate a suitable radio-active element into a compound which will be localized in neoplastic tissue so that intense radiation can be given to the involved area only.

[2] Evans, Hertz, and Means are carrying on similar studies.

The work of Kruger (6) lies in this general direction. Although it is known that fast neutrons are effective in destroying tissue, slow neutrons *per se* are relatively harmless when they are directed into tissue. When, however, slow neutrons are directed into the element boron, the nucleus of boron captures a slow neutron and then literally explodes, emitting two heavy ionizing particles in opposite directions—an alpha particle and a lithium nucleus, both of which produce dense ionization and, therefore, are effective in destroying tissue. In Kruger's experiments, tumor fragments were bathed in a non-toxic solution of boric acid and then irradiated with slow neutrons. In experiments carried out on three different mouse tumors, he has shown that by this method the tumor particles can be *killed* with a small background of fast *neutrons* which in themselves are harmless. Here again, from the standpoint of therapy, the problem resolves itself into one of developing a method of localizing *boron* to neoplastic tissue, possibly by attaching boron to a compound which would be selectively absorbed by this tissue. If this could be done, then the area could be bathed in slow *neutrons* which would damage the tissue only in the presence of boron atoms.

2. *The Substitution of Artificially Radio-active Substances for Radium in Direct Radium Therapy.*—Although the *cyclotron* (7) is capable of producing artificially radio-active substances in large quantities on a commercial basis, there seems to be no reason to use this form of substitution therapy at the present time, unless radium or radon is not available. The whole atomic table has not yet been explored systematically with the idea of substitution of radio-active substances for radium in mind, but several isotopes have already been found which could be used. Sodium^{22} which emits positrons and has a half life of three years has been made in quantities of two to three millicuries in the cyclotron, while sodium^{24} which emits beta and very hard gamma rays, has a half life of 14.8 hours and has been made

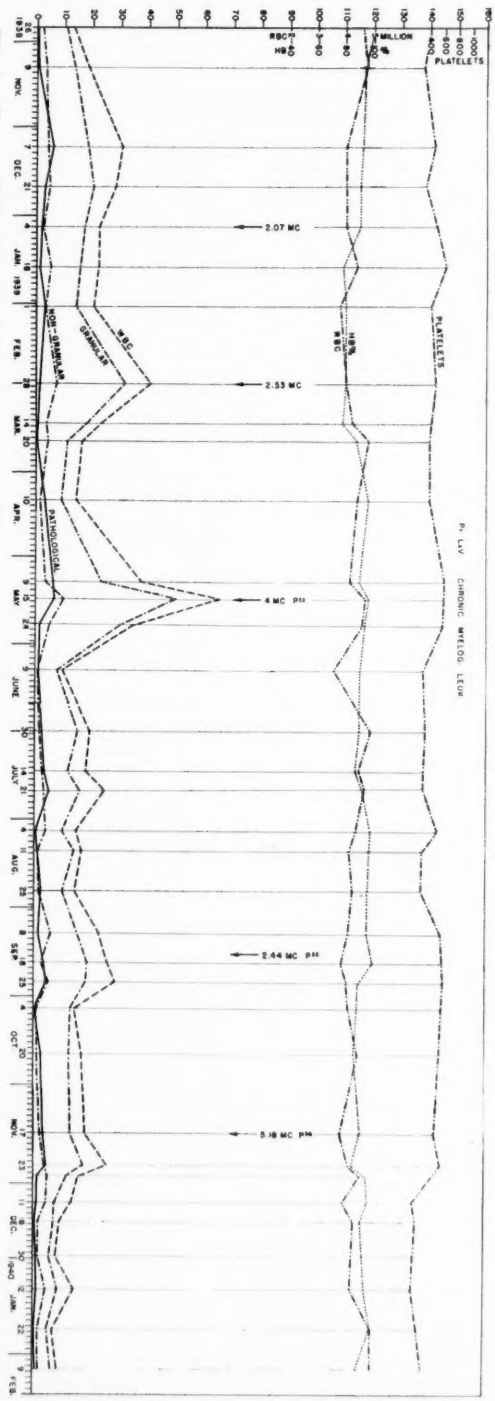

Fig. 1. Course of blood picture in Case 1, chronic myelogenous leukemia. The granular cells represent segmented and non-segmented polymorphonuclear cells, the non-granular represent lymphocytes and monocytes, and the pathologic represent myeloblasts and myelocytes. The patient has received orally five different doses of radio-phosphorus. The total amount of sodium phosphate was always kept below a "cathartic" dose.

in high activity (one to two curies in 0.5 gram of sodium). Phosphorus[32], a beta-ray emitter, has a half life of 14.3 days, and can be made in quantities of from 50 to 100 millicuries. Copper[64] emits beta rays and positrons, has a half life of 12.8 hours, and can be made in from 10 to 15 millicurie quantities. Finally, several millicuries of iodine[126], with a half life of 13 days, have been made. Any one of these, and probably many other isotopes still unknown at the present time, can thus be used as substitutes for radium in radium seeds or bombs. If a special quality of radiation, such as pure beta rays (P^{32}) or gamma rays harder than those from radium (Na^{24}), should be required, these artificially radio-active isotopes may come into therapeutic use.

3. *The Oral and Parenteral Administration of Radio-active Phosphorus in Therapy.*—When radio-phosphorus, incorporated into a compound such as sodium phosphate, is fed to or injected into animals or man, bone and bone marrow eventually retain the highest concentrations of the phosphorus atoms. Since P^{32} emits beta rays which produce their ionization in the immediate vicinity of the phosphorus atoms, this material seems to offer a method of giving localized irradiation in diseases of the bone marrow such as metastatic carcinoma to bone and multiple myeloma; at the present time we are attempting to treat these diseases by oral administration of this material in the form of sodium phosphate. In addition to this relatively great deposition in bone and bone marrow, there is in animal and human leukemia a rather high concentration of these phosphorus atoms wherever leukemic infiltration occurs, such as in lymph nodes,

spleen, and liver (3, 4). Since the phosphorus atoms decay rapidly (half life 14.3 days) and are eventually excreted in urine and feces, it has seemed reasonable to attempt to treat leukemia in this way. Two years of experience with various types of leukemia have demonstrated the value of this material in producing remissions in cases of chronic myelogenous and chronic lymphatic leukemia. Since chronic leukemia is a variable disease, it is too early to estimate fairly the value of this form of therapy as compared with others, such as x-rays and arsenic, particularly in prolonging life, but it seems worth while to describe the methods used and the responses obtained in a few representative cases.[3]

Case 1. The patient, a 58-year-old American housewife suffering from chronic myelogenous leukemia, was referred to us for treatment by Dr. Ruth Harmon and Dr. W. H. Sargent. The diagnosis of leukemia was made in May, 1934. She had received no treatment until June,

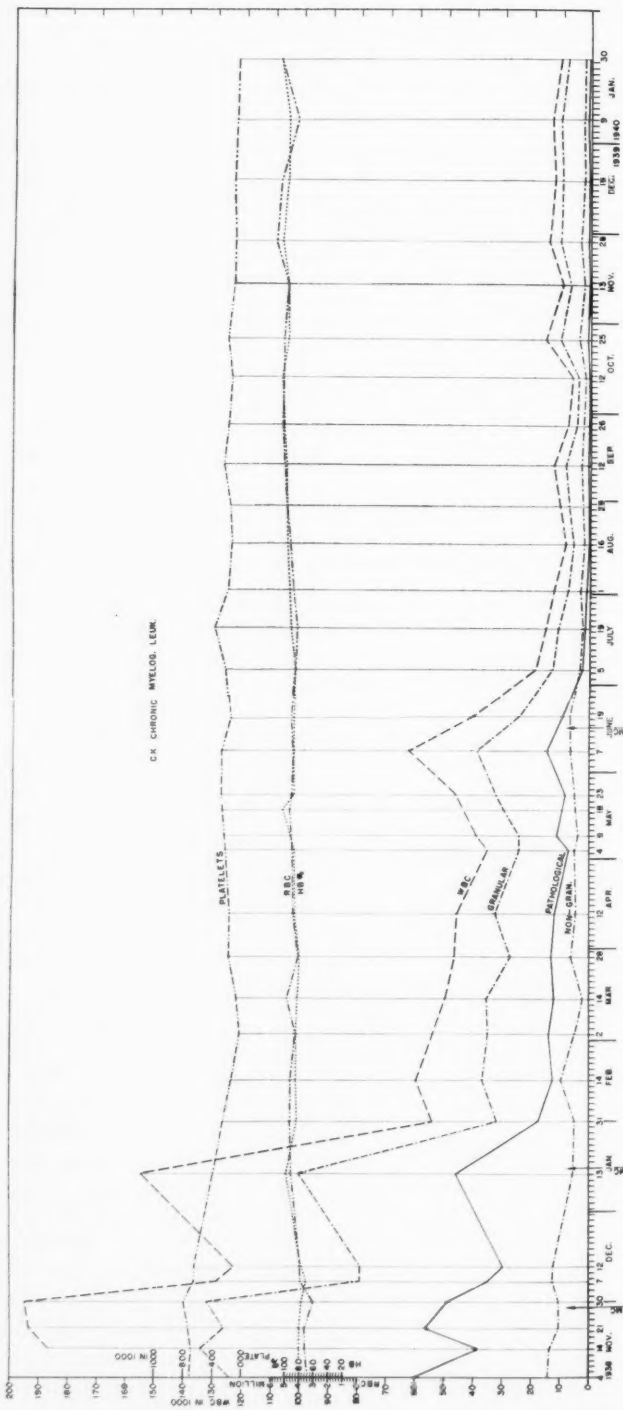

Fig. 2. Course of blood picture in Case 2, myelogenous leukemia. The patient has received three different doses of radio-phosphorus, the last in June, 1939. At the present time the number of white and red blood cells is normal, and careful searching reveals a rare myelocyte in the blood smear.

[3] These and other cases will be reported in more detail in a forthcoming article entitled "Further Studies on Leukemia with the Aid of Radioactive Phosphorus," by Lawrence, Erf, and Tuttle.

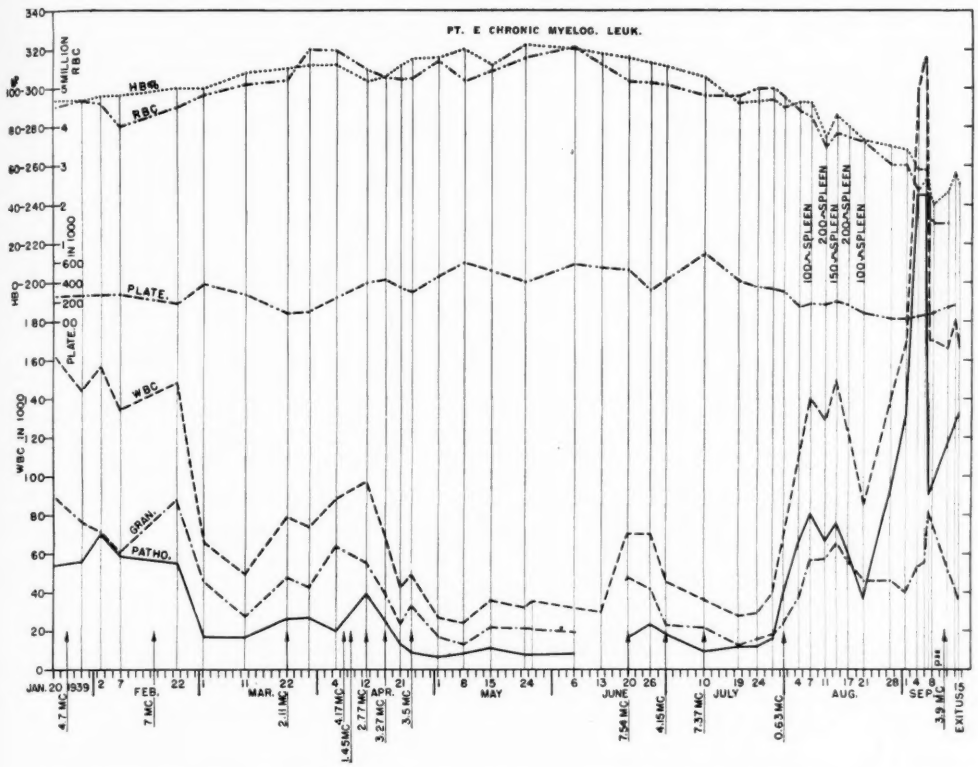

Fig. 3. Course of blood picture in Case 3, chronic myelogenous leukemia. Many doses of radio-phosphorus were administered, with a favorable response during the first six months. Thereafter, the pathologic white cells increased, and there was no response to further x-radiation.

1935, when Dr. Sargent first saw her. At that time the blood picture was as follows: Hemoglobin, 75 per cent (12.6 gm.); red blood cells, 3,130,000; white blood cells, 208,000; polymorphonuclears, 50.5 per cent; mononuclears and lymphocytes, 13 per cent; eosinophiles, 1.5 per cent; basophiles, 33 per cent; myeloblasts, 2 per cent. Between July 1, 1935, and Aug. 31, 1938, the patient was given by Dr. Sargent six courses of high voltage x-ray treatments to the spleen and chest. During this time considerable improvement occurred in the blood picture and the clinical condition. When we first saw the patient on Oct. 26, 1938, she was in good clinical condition. The spleen, liver, and lymph nodes were not enlarged, and the blood picture was as follows: Hemoglobin, 106 per cent; red blood cells, 4,600,000; white blood cells, 13,400; polymorphonuclears, 74 per cent; lymphocytes, 12 per cent; mononuclears, 4 per cent; myelocytes, 2 per cent; platelets, 395,000. The patient continued to do well until January, 1939, at which time there was a rise in the white cells and a leukemic skin rash developed. She was given orally approximately two millicuries of radio-phosphorus in the form of sodium phosphate (1.8 grams), and as a result the rash disappeared. The course of the blood picture is shown in Figure 1, and it is to be noted that up to the present time she has received five different doses of radio-phosphorus, which were given whenever the number of white cells rose or leukemic infiltration of the skin occurred. Regularly following treatment these untoward signs have disappeared, and at the present time the patient is in excellent

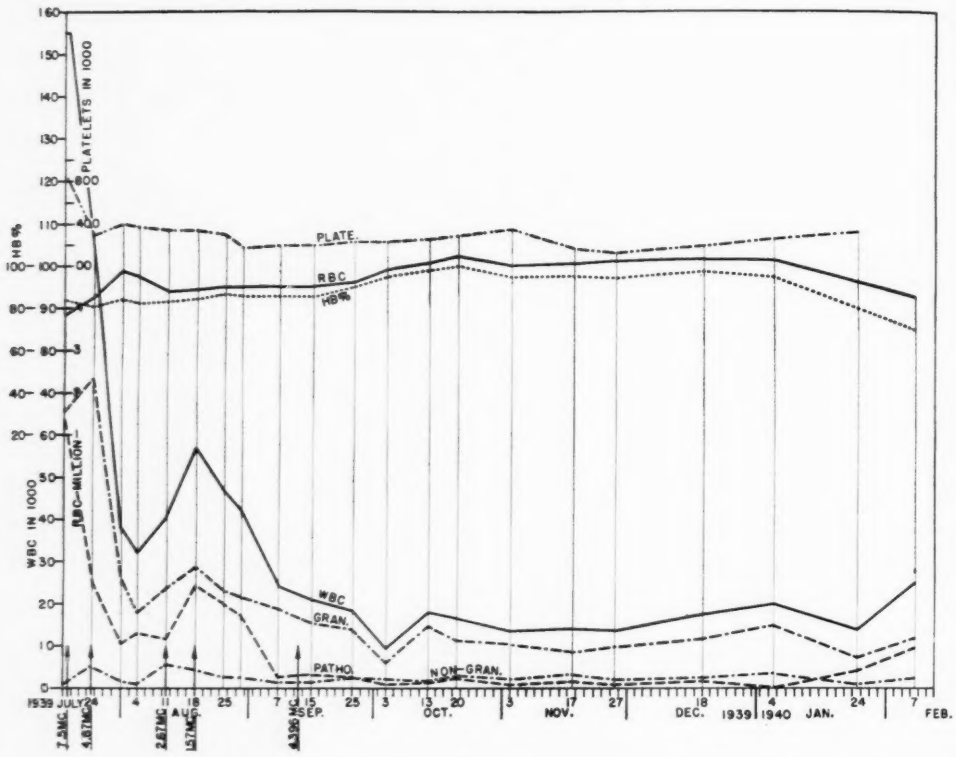

Fig. 4. Course of blood picture in Case 4, chronic myelogenous leukemia, with satisfactory response to administration of radio-phosphorus.

clinical condition with a nearly normal blood picture (1–2 per cent myelocytes). Undoubtedly she has a mild form of leukemia.

Case 2. This patient, a 29-year-old male, American, graduate student, was found to have chronic myelogenous leukemia in the Fall of 1938. He was referred to us in November, 1938, by Dr. Paul Michel and Dr. William G. Donald, without having received any treatment. At that time he was suffering from anemia, and the liver and spleen were greatly enlarged. The blood picture showed a high percentage of myelocytes. Sternal puncture by Dr. Michel showed the picture of myelogenous leukemia. In Figure 2 is charted the course of his blood picture under radio-phosphorus therapy. Shortly after the oral administration of the first dose, he improved clinically and has remained symptom-free for one year at the present writing. After long study of the stained smear it is now possible to find a rare myelocyte. As seen in Figure 2, this patient has received three different doses of radio-phosphorus and has had a satisfactory response. The liver and spleen are not palpably enlarged at the present time, and physical examination is normal.

Case 3. This patient, a 39-year-old American business man who had been treated for chronic myelogenous leukemia with x-radiation since September, 1937, was referred to us for radio-phosphorus therapy in January, 1939, by Dr. Kenneth Jenkins. In Figure 3 are charted the blood picture and the P^{32} dosage. For a period of six months the patient responded well from both the clinical and hematologic standpoint. The spleen became impalpable, the red blood cells gained normal levels.

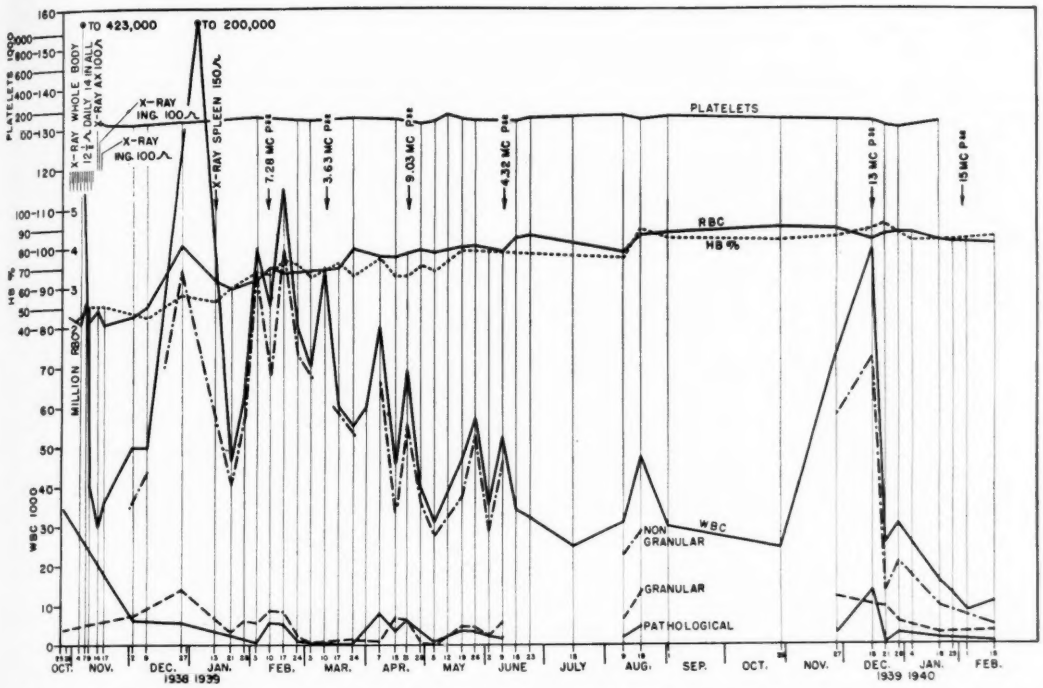

Fig. 5. Course of blood picture in Case 5, chronic lymphatic leukemia. After a preliminary course of x-ray therapy, the patient has received several doses of radio-phosphorus, and has remained in good clinical condition. The pathologic cells represent blasts.

and the white blood cells stayed relatively low. However, in spite of continued small doses of phosphorus and further x-radiation, anemia developed and progressed, the spleen and liver enlarged, the white blood cells increased, and the patient died. Typical myeloid leukemia was found at autopsy.

Case 4. This patient, a 39-year-old single American woman, suffering from chronic myelogenous leukemia, who had been treated with x-rays over a period of two years, was referred to us by Dr. C. A. Wilcox in June, 1939. At that time her blood picture showed a definite elevation of the white blood cells (Fig. 4), a high percentage of myelocytes, and anemia. The spleen was enlarged to a point midway between the ribs and the umbilicus. The liver was also palpably enlarged. The course of treatment with radio-phosphorus and the course of the blood picture are shown in Figure 4. A decrease in the number of white cells and an improvement in the red blood cell picture are noted. Associated with these was a great improvement in the general clinical condition, including decrease in the size of the spleen, which is now impalpable.

Case 5. This patient, a 54-year-old Austrian-American male, was referred to the University of California Medical Clinic by Dr. Edward Radford. He had generalized lymphadenopathy and markedly enlarged liver and spleen. The blood picture revealed an elevated white count with a high percentage of lymphocytes and a severe anemia. Lymph node biopsy and sternal biopsy by Dr. S. R. Mettier confirmed the diagnosis of chronic lymphatic leukemia. He was given a transfusion and irradiation with x-rays over the whole body (Fig. 5). His condition improved slowly. On Feb. 10, oral administration of radio-phosphorus was begun (the doses he has received are entered in Figure 5). Under

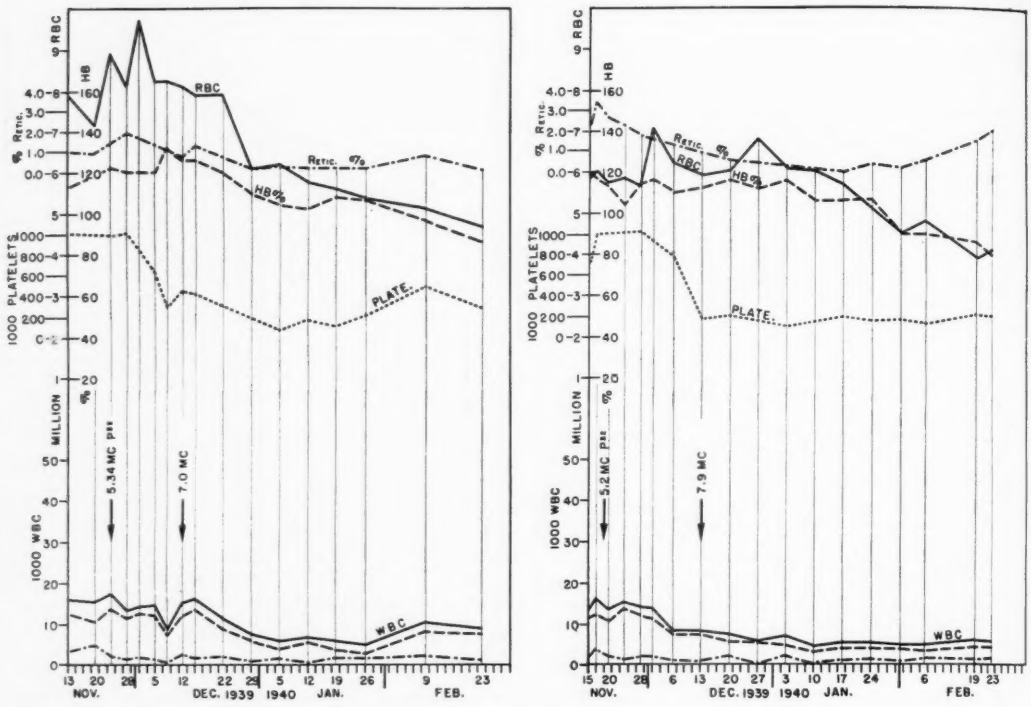

Fig. 6. Course of blood pictures in two patients suffering from polycythemia vera, treated with radio-phosphorus (Cases 6 and 7). In both patients the hemoglobin and red blood cell values have fallen satisfactorily, with decreases in the reticulocyte counts.

this régime the patient has responded well clinically. The liver and spleen are now not palpably enlarged. The white and red blood counts are satisfactory, although the differential count continues to show an elevated number of lymphocytes, a small percentage of which are blasts. The lymph nodes have decreased to approximately one-half the size they were before radio-phosphorus therapy was given.

Discussion.—These five representative cases of chronic myelogenous and chronic lymphatic leukemia, treated by the oral administration of radio-phosphorus in the form of sodium phosphate, have shown responses similar to those usually following x-ray or radium therapy. In order to avoid a cathartic effect, the total amount of sodium phosphate administered has been kept below three grams; in order to avoid the formation of insoluble iron phosphates and consequently poor phosphorus absorption, no iron has been given orally during radio-phosphorus administration. The dosage of radio-phosphorus has been determined by clinical trial and animal experimentation and is probably much too small. In no case has the patient received more than an equivalent of 3 r daily whole body irradiation. The frequency of treatments has been determined by the clinical responses. Much more work on many patients over a period of years must be carried out before evaluation of this new form of therapy can be made. Advantages of this method of treatment are: (1) It is a means of giving whole body irradiation continuously over a period of two or more weeks, in a single oral dose of sodium phosphate; (2) there are no irradiation reactions.

Since polycythemia vera is presumably a disease limited chiefly to the bone marrow and radio-phosphorus concentrates in bone

and bone marrow and thus gives selective irradiation, it seemed reasonable to attempt to treat also polycythemia vera with radio-phosphorus. During the past four months we have studied the effects of radio-active phosphorus on two patients suffering from this disease. Their brief case reports follow.

Case 6. This patient, a 42-year-old married American woman, suffering from polycythemia vera, was referred to us by Dr. Wallace T. Partch in November, 1939. The duration of her disease was about two years, and she had been treated with phenylhydrazine. As noted in Figure 6, the patient was given orally two doses of radio-phosphorus in the form of sodium phosphate. As a result, there was a fall in the hemoglobin and red blood cells, preceded by a decrease in the reticulocyte counts, without evidence of blood destruction. Frequent urobilinogen tests and icteric indices were negative; also the total number of white cells decreased. Symptomatically the patient is much improved and is practically free of headaches at the present time. It would appear that the radio-phosphorus has acted by inhibiting the formation of red cells in the marrow. This patient will receive further radio-phosphorus only if symptoms return in the presence of a rising number of red blood cells.

Case 7. This patient, a 59-year-old American woman, suffering from polycythemia vera, was referred to us by Dr. William B. Chew, who has assisted in following the clinical course. Her symptoms had extended over a period of two years, and she had been treated by repeated bleedings. The blood picture and hematologic course are charted in Figure 6. Two doses of radio-phosphorus were administered approximately ten days apart, and, as in the previous case, resulted in a marked fall of hemoglobin and red blood cells, associated with some decrease in the white blood cells, accompanied by nearly complete relief of all symptoms. Again there was a fall in the reticulocyte counts, and no destruction of red blood cells was evident. (Repeated icteric indices and urobilinogen tests have been negative.[4])

SUMMARY

1. The possible uses of the artificially radio-active isotopes in medical investigation and therapy have been briefly discussed.

2. Preliminary results of the treatment of chronic leukemia and polycythemia with radio-phosphorus are given.

The investigations here reported have been made possible through a grant from the John and Mary R. Markle Foundation for Medical Research, and the radio-phosphorus has been made available by the generous co-operation of the staff of the Radiation Laboratory.

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DISCUSSION

FRED J. HODGES, M.D. (Ann Arbor, Mich.): When radio-active sodium was for the first time introduced by vein into the circulation of a human being, it was my good fortune to be visiting at the

[4] Cases 1, 2, 6, and 7 continue to be normal (June 18, 1940), without further treatment. Case 5 is presumably doing well but has not returned recently for observation. Case 4 continues well, and has received two further doses of radio-phosphorus.

radiation laboratory and the Department of Roentgenology at the University of California. The paper presented by Dr. John Lawrence was, therefore, particularly interesting to me for he has shown us that the therapeutic use of radio-active materials within the body has developed tremendously in four short years. In answer to the question uppermost in my mind in 1934, he has shown us that radio-active materials intravenously introduced do have some selective activity within the body. It is not to be expected that the entire body will be exposed indiscriminately when radio-active salts are employed in the treatment of diseases such as leukemia. Dr. Lawrence works a bit closer than Dr. Bale to the specialized field of clinical radiology, and it seems highly probable that we will have to pay close attention to work of this sort in the years to come.

PRIMARY CARCINOMA OF THE LUNG[1]

REPORT OF TWO CASES

By CHARLES H. KELLEY, M.D., *Chicago*[2]

From the Division of Roentgenology, Provident Hospital

TWO cases of proved primary carcinoma of the lung are presented herein. One lived more than seven months after having been given deep roentgen-ray therapy. The tumor regressed considerably after irradiation, and the patient was ambulatory and fairly comfortable until the last few weeks preceding death. The other, an advanced case with distant metastasis, died 18 days after admission to our hospital. He received a single palliative treatment. In both cases the diagnosis was suggested by chest roentgenograms and proved by bronchoscopy and biopsy. The report of necropsies, done by A. C. Webb, M.D., of Provident Hospital, is included herein.

Case 1. J. M., Negro male, porter for 20 years, aged 55 years, entered Provident Hospital on Feb. 27, 1938. He was markedly orthopneic and dyspneic and had lost 30 pounds in weight in two months. His cough—mostly mucopurulent in character—dated back a year. At the date of admission, his illness was diagnosed as bronchopneumonia. For the last two weeks prior to admission, blood-tinged sputum was expectorated and there were severe pains in the right chest. The patient was obviously ill and in considerable respiratory distress when first seen at our hospital. The white blood cell count was 7,400; red blood cell count, 4,800,000; hemoglobin, 80 per cent; Wassermann and Kahn tests were negative.

On Feb. 28, 1938, stereoscopic films of the chest showed an area of increased density, somewhat circular, in the right side of the hilum. There were no roentgen signs of atelectasis. Productive processes were present in the middle and lower right lobes. The pleura was thickened, but there was no fluid in either pleural cavity. The roentgen findings were suggestive of primary carcinoma of the lung and probable bronchiectasis (Fig. 1).

On March 2, 1938, J. R. Lindsay, M.D., of Billings Hospital, did the bronchoscopy and biopsy. His report reads: "One centimeter from the carina a granular-looking swelling bulged into the posterior wall of the right main bronchus constricting its lumen to less than one-half its normal size. After biopsy, the lower lobe bronchus could be seen. Some purulent secretion came up after coughing. Impression: probable carcinoma of right main bronchus." Microscopic diagnosis of biopsied tissue showed small cell carcinoma of bronchus. Roentgen examinations of the usual sites for skeletal metastasis were negative.

On March 3, 1938, deep roentgen-ray therapy was begun with the following factors: 200 kv.p. (constant potential), 10 ma., S.T.D. 50 cm., filters 1.0 mm. Cu plus 1.0 mm. Al, portals 10 × 15 cm. Five portals were used.[3] The method of cross-fire was employed. The location of the tumor was determined from films and bronchoscopic findings. Approximately 9,000 r, measured in air, without the scatter factor, were given: rate, 200 r at 24-hour intervals. Nausea was experienced by the patient for four or five days.

Two weeks later, the patient had improved to such an extent that he was allowed to go home and return to the x-ray department for daily treatments as an ambulatory patient. There was regression of his tumor after irradiation (Fig. 2). He enjoyed months of comfortable living.

[1] Accepted for publication in February, 1939.

[2] Present address, Washington, D. C.

[3] Portals used were two anterior, two posterior, and one right lateral.

We feel that this measure of comfort fully justified irradiation in this case.

On Sept. 10, 1938, the patient first observed a rather firm mass in his upper right abdomen. The mass was tender to touch, but not very painful. The patient refused hospitalization, and we lost sight of him for four weeks. When seen again, he was bedridden. He died on Oct. 20, 1938, with extensive metastasis to the liver.

Necropsy Report.—This was the body of an emaciated male, approximately 55 years old. No superficial adenopathy was present. On opening the abdomen, the liver was found to be grossly enlarged; many grayish-brown nodules were present on its surface. Similar nodules were seen scattered throughout the parenchyma of the liver as observed on cross-section. The liver weighed 3,960 grams.

The lungs did not collapse when the chest was opened. Extensive, dense, fibrous adhesions were present between the lungs and the thoracic walls. The intrathoracic portion of the trachea contained several pale, reddish nodules, firm in consistency. Similar nodules were present in the right bronchus, the latter of which were larger. No nodules were present in the left bronchus. The lumen of the bronchus was narrowed but not closed. Reddish-brown masses, replacing lung tissue, were seen in the middle and lower right lobes. Regional lymph nodes were involved by the process. The left lung showed compensatory emphysema.

The remaining organs of the body showed no significant pathologic findings. Sections from the liver and masses in the lung disclosed the same type of cells as found in the primary tumor of the right bronchus, namely, undifferentiated carcinoma.

Case 2. O. S., Negro male, 50 years of age, cigar maker, was first seen on Aug. 19, 1938. He gave the following history: For two years he had had a chronic productive cough, with the raising of mucous material. On May 14, 1938, he was seized with severe pain in his right upper chest—the pain gradually subsiding. On Aug. 19, during a coughing spell, several blood clots were raised. Since June, 1938, he had

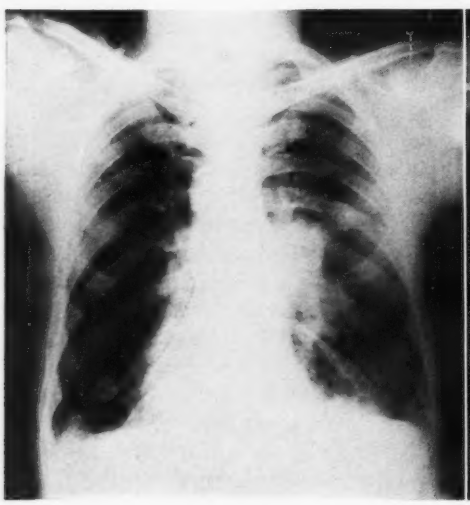

Fig. 1.

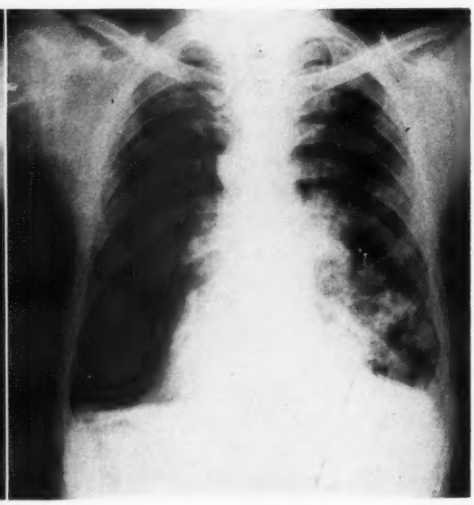

Fig. 2.

Fig. 1. Case 1. This film was made before irradiation and shows a highly undifferentiated bronchogenic carcinoma near the right hilum. No atelectasis present.

Fig. 2. Case 1. This film was made after irradiation (9,000 r, without scatter factor). The tumor mass appears to have decreased in size.

observed a hard mass in his upper right abdomen, tender to touch, but not very painful. This mass gradually increased in size so that he felt that, at present, it was considerably larger than originally.

General weakness and loss of weight had been progressive during the past two months. The patient was admitted to Provident Hospital the same day he was seen. Physical examination revealed indefinite chest findings, but with definite signs of consolidation of the right upper lung.

Palpation of the abdomen revealed a tumor mass occupying the right epigastric and hypocondriac regions, with sharp edges extending almost to the level of the right iliac crest. The sclera of his eyes were moderately jaundiced. The laboratory findings were as follows: The Van den Bergh was immediately direct and his icteric index was 63.5. The Wassermann and Kahn tests were negative. The white blood cell count was 10,000; red blood cell count, 4,100,000; polpmorphonuclears, 89 per cent; small lymphocytes, 11 per cent.

On Aug. 23, 1938, stereoscopic films of the chest showed atelectasis of the right upper lobe resulting from occlusion of the bronchus to this lobe (Fig. 3). The pleura was definitely thickened over this lobe and there was no fluid in either pleural cavity. A diagnosis of probable primary carcinoma of the lung, with atelectasis of the right lobe and metastasis to the liver, was made.

On Aug. 26, 1938, Dr. J. R. Lindsay, assisted by Dr. Lennarson, did the bronchoscopy and biopsy. Their report read: "The right upper lobe bronchus was occluded. No mass was present. The right main stem bronchus was collapsed to a narrow slit. Its walls appeared thickened and were definitely friable. Impression: probably carcinoma involving the right upper lobe and right main stem bronchi." Several pieces of tissue had been removed for biopsy.

On Aug. 29, 1938, microscopic diagnosis was small cell (undifferentiated) carcinoma of bronchus. A single palliative dose of deep roentgen-ray treatment was given. It was inadvisable to attempt further treatment of any sort, and the patient died on Sept. 6, 1938.

Necropsy Report.—The body was that of a thin, emaciated male, appearing to be approximately 60 years of age. His skin was moderately jaundiced. No superficial adenopathy was present.

On opening the abdomen, a moderate amount of thin, amber-colored fluid escaped. The surface of the liver exhibited numerous nodular masses varying in size, grayish-pink in color, the nodules scattered throughout the parenchyma of the liver, as seen on cross-section. The liver weighed 4,200 grams. Sections were taken for microscopic study.

The necropsy report of the lungs showed the surface of the upper lobe of the right lung to be torn and ragged—the site of old fibrous adhesions that bound the lung firmly to the thoracic wall. Moderate adenopathy of regional lymph nodes was found. The mucosæ of the trachea and left bronchus were smooth and pinkish. In the right bronchus, 1.5 cm. from the bifurcation of the trachea, there was a raised, pale cream-colored area which completely obstructed the main bronchus to the collapsed upper lobe. This lesion ex-

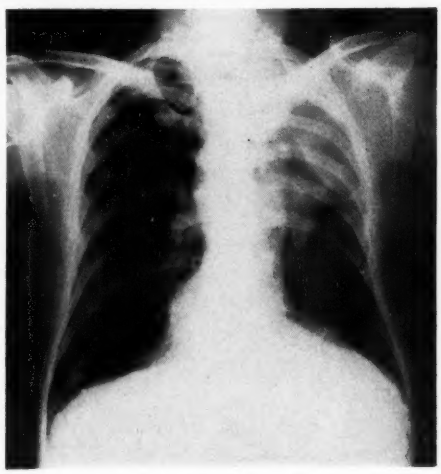

Fig. 3. Case 2. A roentgenogram of the chest showing atelectasis of the right upper lobe resulting from occlusion of the bronchus to this lobe by an undifferentiated bronchogenic carcinoma.

tended into the hyparterial branch which was narrowed but not obstructed. Its lumen was 4 mm. in diameter. Examination of other parenchymatous organs, including the brain, did not reveal evidence of metastases. These organs showed no significant pathologic changes. The cells of the sections taken from the involved bronchus and liver were identical—undifferentiated carcinoma.

CONCLUSIONS

1. Two cases of proved primary carcinoma of the lung have been presented. The diagnosis was confirmed by bronchoscopy and biopsy. One case illustrates a fairly good palliative result after deep roentgen-ray therapy, in which the tumor definitely regressed. Death took place seven months and 17 days after treatment. The other patient died 18 days after admission to the hospital.

2. In Case 2, the primary tumor was quite small. The metastasis to the liver was extensive, the latter being the main disturbing factor to the patient.

3. The roentgen picture of primary carcinoma of the lung, although striking, is not diagnostic. It must be interpreted in the light of the history and clinical findings. Bronchoscopy and biopsy are necessary in order to confirm the diagnosis and to determine the cell type while the patient is living.

ROTATION THERAPY[1]

By S. J. HAWLEY, M.D., G. F. Geisinger Memorial Hospital, *Danville, Pennsylvania*

ROTATION therapy is a method of treatment of deep-seated lesions in which the patient is rotated continuously in the beam with the central ray directed through the center of the volume to be treated. This may be done by moving the tube around the patient or, more simply, by rotating the patient. It is most easily accomplished by directing the beam horizontally. The patient stands (or sits on a support so that the legs are practically vertical) on a small platform raised a little above the floor. The x-ray tube is turned up through 90 degrees so that the beam is directed at the patient and is parallel to the floor. The platform is connected by reduction gears to an electric motor so that it turns slowly on a vertical axis. Figure 1 is a drawing of such an arrangement.

The idea is neither new nor original. It was suggested to me by Dr. Wheeler P. Davey, Professor of Research Physical Chemistry of Pennsylvania State College, in 1930. A similar idea was used by Flax (1) who moved the tube through an arc of 60 degrees over the patient. Du Mesnil de Rochemont (2) and Dessauer, Lion, and Gokmen (3) have worked out the basis and methods of calculating dosage by this method. Their findings and conclusions are practically identical with those presented here.

The advantage of this method results from the fact that, by rotating the patient in the beam, there is a volume surrounding the axis of rotation which is in the beam continuously during the irradiation. All the tissue outside of this cylinder is irradiated only as it passes through the beam anterior and posterior to the center of rotation. The more superficial tissues are moving most rapidly and crossing the anterior portion of the beam where it is narrowest. The part of the beam distal to the center of rotation is so reduced in intensity by distance and absorption that its greater width is of no account. This produces, with beams that are not too wide in proportion to the diameter of the part, a condition in which the distribution of radiation within the body is the reverse of that for stationary fields. The greatest intensity is found about the center of rotation, or in the deeper parts of the body, while the skin receives the least.

The amounts of radiation delivered to various parts of a body have been determined by measurements on various sizes and shapes of phantoms made of "pressd wood." All measurements were made with 200 kv. and 25 ma., with a valve-rectified machine. Beams with a half value layer of 1.8 mm. of Cu (composite filter) and H.V.L. of 1.0 mm. of Cu

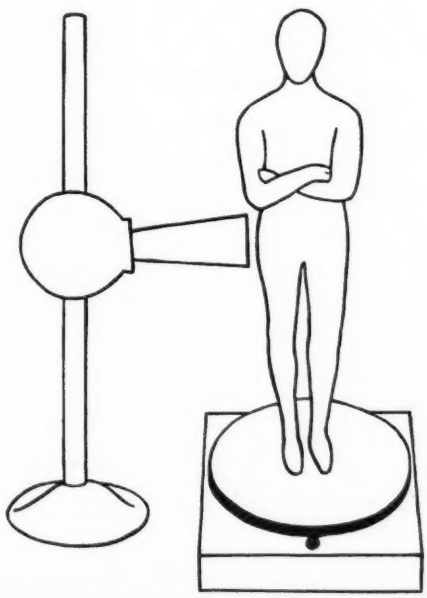

Fig. 1. Diagram of arrangement of tube and patient for rotation therapy.

[1] Presented before the Twenty-fifth Annual Meeting of the Radiological Society of North America, at Atlanta, Dec. 11–15, 1939.

(0.5 mm. Cu filter) were used. The skin–target distance in each instance was 50 cm.

Figure 2 shows the distribution along the transverse diameter of a pelvis-shaped phantom, measuring 40 × 30 cm., with a composite filter, H.V.L. 1.8 mm. Cu. The percentages are given in terms of the point of maximum intensity on the skin, back-scatter included. It was found in every instance that the point of maximum intensity on the skin was at the middle of the broad side of the phantom. The intensity at this point for each size of phantom, port, etc., is taken as 100 per cent.

Four curves are shown in Figure 2, corresponding to four widths of port at the surface; 4 × 20, 7 × 20, 10 × 20, and 20 × 20 cm., the 20 cm. dimension being vertical. These show that, with a narrow port, 4 cm., the central cylinder of radiation receives 1.87 times more than the maximum point on the surface. The 7 cm. field receives 1.43 times more and the 10 cm. field, 1.02 times more. The very wide field receives only 68 per cent or 32 per cent less than the maximum point on the surface. The short vertical lines mark the edges of the beam at the center of the phantom, or the cylinder of continuous radiation.

There is a slight rise in intensity at the edge of the beam in the 7 and 10 cm. ports. This is not sufficient to be of any consequence. If anything, it is a practical advantage, as the peripheral part of a growing tumor, where it is most desired, would get the benefit.

The distribution shown in these curves is practically that in a cylindrical body. If we could treat only cylindrical bodies, these curves would represent the distribution in all diameters. The distribution is different, however, in bodies of irregular shape, like the human pelvis and chest. Figure 3 shows the distribution along the anteroposterior diameter under the same conditions as in Figure 2. The anterior half is similar to that of the transverse diameter, but the falling limb of the curve is convex instead of concave, and the fall at the edge of the beam is not so pronounced. The posterior half is quite different; there is a slight rise between the edge of the beam and the descent to the low point on the surface. However, the amount of this rise is too small to be of practical significance. It could be eliminated by adding a paraffin bustle to make the pelvis more nearly cylindrical.

Distribution curves for a H.V.L. of 1.0 mm. Cu in a 40 × 30 cm. phantom and for both half value layers in 30 × 20 and 20 × 15 cm. phantoms were worked out. These are not reproduced here as the

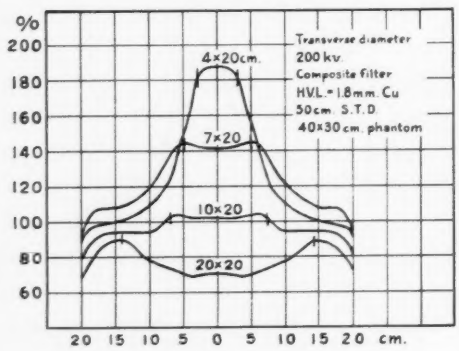

Fig. 2.

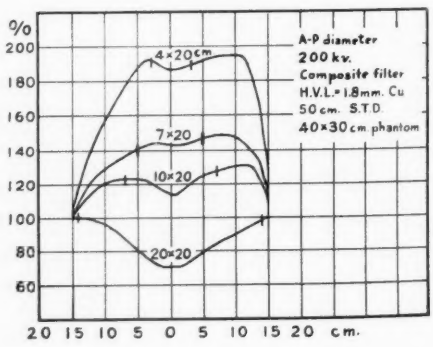

Fig. 3.

Fig. 2. Intensity distribution for four port sizes along transverse diameter of pelvis-shaped phantom, 40 × 30 cm., in terms of maximum intensity on skin equaling 100 per cent H.V.L. 1.8 mm. Cu.

Fig. 3. Intensity distribution for four port sizes along anteroposterior diameter of pelvis-shaped phantom, 40 × 30 cm., in terms of maximum intensity on skin equaling 100 per cent H.V.L. 1.8 mm. Cu.

pattern is the same, only the absolute values changing.

Figures 4 and 5 give the actual dosage for the cylinder about the axis of rotation and the maximum skin dose for 200 kv., composite filter, H.V.L. 1.8 mm Cu; and Figures 6 and 7 for the same factors but for 0.5 mm. Cu filter, H.V.L. 1.0 mm. Cu, for various sizes of cross-section and for four port sizes. These ports all have the 20 cm. dimension parallel to the axis of rotation; only the width is varied. Change in the long vertical dimension does not have as much effect on the dosage as changing the width.

The curves in Figures 4, 5, 6, and 7 are all based on the roentgens measured in air at 50 cm. as 100 per cent. This is used as the basis, as the surface dose not only varies with each field size but also with each difference in cross-section, while the amount measured in air is a constant. Furthermore, the surface dose is unimportant except when large fields in proportion to the cross-section diameter are used, because the surface will receive much less than the interior. The percentages read from the curves for the surface dosage include back-scatter.

The size of the cross-section is expressed in the average diameter. This is a legitimate procedure as it has been found by actual measurement that changes in the anteroposterior diameter in relation to the transverse diameter within the limits found in the human body do not change significantly the depth dose nor surface dose, for, as the body rotates, the cross-section diameters are automatically averaged.

The rate of rotation has no influence, as long as at least one complete rotation is accomplished.

The only distance described is a skin–target distance of 50 cm. Increasing the distance above this improves the ratio of deep-to-surface dosage, but, as with stationary fields, efficiency is lost because of the prolongation of treatment time. An ideal, but expensive, method would be to use very long distance and radiate simultaneously with several tubes.

The actual dosage delivered to the cylinder about the axis of rotation is very nearly the same as one might expect with a stationary field with the same beam size, radiation of the same quality, the same skin–target distance, and the same depth beneath the surface. We see, then, that rotation therapy does not directly increase the depth dose; the percentage of depth dose when compared to the dose in air is the same as for stationary fields, but the dose to the superficial structures is reduced. Therefore, the maximum dosage which we can safely deliver is limited by the

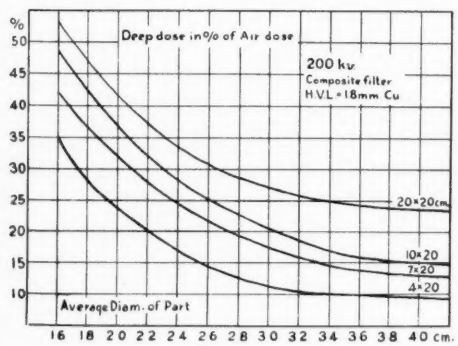

Fig. 4.

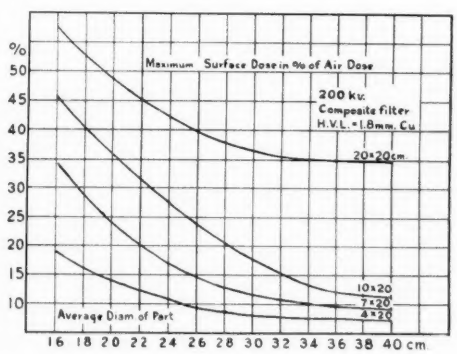

Fig. 5.

Fig. 4. Intensity of radiation in cylinder of continuous radiation for various diameters of part and four port sizes in percentage of intensity in air at the surface, H.V.L. 1.8 mm. Cu.

Fig. 5. Intensity of radiation at maximum point on skin for various diameters of part and for four port sizes in percentage of intensity in air at surface, H.V.L. 1.8 mm. Cu.

amount of radiation the deep structures about the tumor can stand, rather than what the skin can stand. The patient will be relieved of painful dermatitis, while the tumor and its bed may be given as much as is desirable.

The rotation method is no more difficult to apply to the patient than is conventional cross-firing. It is important to choose as portal size one great enough to include all the tumor, just as in non-rotating methods. Some simple means of rotating the patient is all that is necessary to add to the ordinary shock-proof treatment machine. Slow rotation is more comfortable for the patient. The writer's turntable turns once a minute. The patient may stand or, better, be supported by an arrangement similar to a bicycle seat, adjustable to height, the supports of which offer no obstruction to the beam. This will make the patient more comfortable and lessen the likelihood of moving off center. A swivel-mounted strap from the ceiling, for the patient to hang on to, will give added support and keep the arms out of the way. This method is not applicable, of course, to the patient who is too sick to sit up.

It is not difficult to center the patient. Small displacements from exact centering will not affect the distribution within the body, but, of course, may allow some part of the area to be treated to fall outside of the cylinder of intense radiation. For this reason the centering should be as exact as possible.

Six patients are now being treated by this method. Not sufficient time has elapsed, nor is the series large enough to warrant the reporting of results. No difficulties have been encountered in these few cases. Nausea and vomiting appear to be less than by the use of multiple stationary fields. I have started with small daily and relatively small total doses, intending to increase both until I find what is the optimum daily dose and what is a safe dose to apply to the interior. The maximum daily dose given to date is 200 r into the tumor area. One patient has completed a course of 2,000 r in four weeks into the tumor area for carcinoma of the cervix. There was moderate inflammation of the upper vagina and sloughing of the diseased cervix. There has been no diarrhea and no bladder irritation. There is barely discernible tanning of the skin.

SUMMARY AND CONCLUSIONS

A method of treating deep-seated lesions by rotating the patient in the beam is presented. Curves are shown giving the distribution of radiation within the body and also the deep and surface doses for cross-sections of various sizes, and for

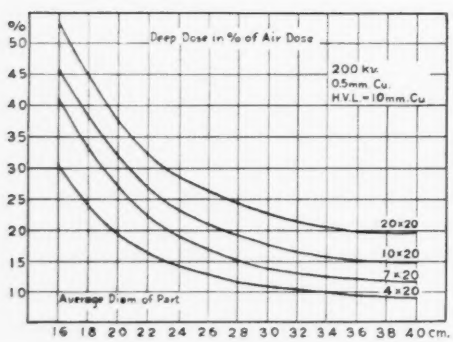

Fig. 6.

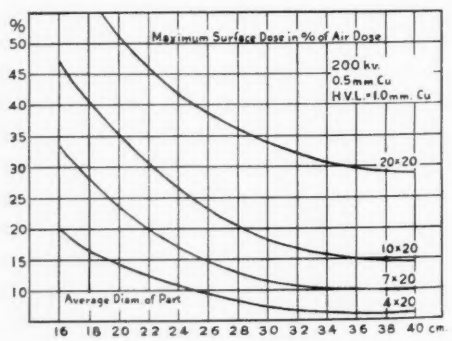

Fig. 7.

Fig. 6. Intensity of radiation in cylinder of continuous radiation for various diameters of part and four port sizes in percentage of intensity in air at surface, H.V.L. 1.0 mm. Cu.

Fig. 7. Intensity of radiation at maximum point on skin for various diameters of part and for four port sizes in percentage of intensity in air at the surface, H.V.L. 1.0 mm. Cu.

various port sizes at two different qualities of x-rays. These show that:

1. Such a method greatly reduces the irradiation of the skin and superficial structures as compared with the amount given to the deep structures with fields that are not too wide.

2. The distribution of the radiation in the body is advantageous, as the cylindrical area surrounding the axis of rotation is the most intensively rayed.

3. The advantageous ratio between deep and surface doses is greater with large bodies, small fields, and short wave length.

4. With wide fields, such as will be required for large tumors in small patients, a great deal of the advantageous ratio of surface-to-depth dose is lost, yet the advantage of more certain and uniform distribution of radiation within the body, as compared with multiple stationary fields, remains.

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DISCUSSION

LEWIS G. JACOBS, JR., M.D. (Winona, Minn.): There is one point that strikes me as being of considerable importance, although perhaps it is not of great interest. The condition under which the doctor gets the best advantage to this method is by using a very small beam; and in getting that best advantage, he has a very uneven gradient of radiation throughout the body.

Now, it is frequently true that the tumor we are treating cannot be said to be localized to a small area. It would seem to me that steep gradients would leave too much opportunity to fail to treat sufficiently important parts of the cancer; whereas, if one is to increase the field size to a point at which one is sure of treating all parts of the cancer equally, one loses the advantages of this type of therapy. The practical end of this only time can tell, but I feel that is something to which thought should be given.

DR. HAWLEY (*closing*): The point that Dr. Jacobs brought up is well taken. You must, of course, pick the field size large enough to include all the tumor. However, even with the larger field sizes there is enough definite advantage so that you will be able to radiate more effectively.

The factor that will limit the amount of radiation which you can give is the amount that the tissues around the tumor can stand, and not the amount that the skin can stand. I think that is a definite advantage.

One thing which I did not bring out is the effect of off-centering, which is not important as far as the distribution of radiation is concerned. However, it is important if you leave some of the tumor out of the cylinder of continuous radiation. So, you must center carefully and you must pick a field large enough to include all of the tumor.

RADIATION THERAPY OF CARCINOMA OF THE SKIN[1]

AN ANALYSIS OF 83 LESIONS IN 70 PATIENTS

By PALMER E. WIGBY, M.D., *and* MEYER COHEN, M.D., Department of Radiology, Parkland Hospital, *Dallas, Texas*

THE purpose of this paper is to analyze all cases of epithelioma of the skin treated in this Hospital during the past two years, and to review the recent literature on the subject with the objective of determining the optimum technic for curing the largest number of skin carcinomas by the first series of treatments. It is readily seen that the proper treatment of carcinoma of the skin is an important consideration when one realizes there are about four thousand deaths annually in the United States attributed to carcinoma of the skin.

It is an established fact that treatment by irradiation produces less scarring than any other method. Since most carcinomas of the skin are on the face, irradiation is the treatment of choice from the standpoint of cosmetic effect. Many people with carcinoma of the skin are reluctant to submit to surgical removal, but will submit to irradiation. The curability of these lesions by irradiation, taken as a whole, is estimated to be from 85 to 95 per cent. At least 85 per cent of all skin carcinomas, and at least 95 per cent of all curable skin carcinomas, can be cured by properly administered irradiation alone.

It has long been known (first expressed by Bérgonie and Tribondeau in 1904) that immature cells and cells in the active stage of division are more sensitive to irradiation than are cells which have already acquired their adult or complete morphologic and physiologic characteristics. It is also known that the nucleus is the most sensitive part of the cell, and that the chromatin is the most vulnerable part of the nucleus. Basal cells, having a large amount of chromatin, are, therefore, relatively sensitive to irradiation. Since tumor cells grow more rapidly than normal cells, they are more sensitive to irradiation than are normal cells, and are, therefore, destroyed by smaller doses. The more rapidly growing a tumor is, the more radiosensitive it usually is. There are several exceptions to this rule. Certain malignant melanomas are highly undifferentiated and rapid in growth, but, nevertheless, highly radioresistant. Increased radiosensitivity does not necessarily mean greater radiocurability since the latter involves many other factors, such as metastasis and involvement of bone or cartilage. The more undifferentiated a tumor is, the more likely it is to metastasize early or to infiltrate deeply.

Surface radium application, having a continued effect over a long period of time, is superior to x-ray because it is more likely to act on the cells during their active stage of division. It has, however, the disadvantage of rapid decrease in its depth dose, with the danger of not destroying the cells at the base of deep-seated or infiltrating lesions. The time required for radium treatments and the amount of radium available make its wide use impracticable in our Clinic, and these disadvantages probably hold for many other clinics in this country. Soft x-rays have the same disadvantage of decrease in depth dose. Like radium, they are suitable for superficial lesions.

According to the Arndt-Schulz Law of irradiation, biologic activity is accelerated by small doses, suspended by moderate doses, and destroyed by large doses of irradiation. It is important, therefore, to give a large enough dose to destroy all the cells of the tumor. The dose must not, however, be large enough to cause serious damage to surrounding tissue.

[1] Accepted for publication in August, 1939.

The difference between the lethal dose of tumor tissue and surrounding normal tissue is greater with short wave length radiation; that is, rays produced by higher kilovoltage and heavier filtration, and the gamma rays of radium. Heavily filtered high voltage x-rays provide more uniform distribution of radiation and a greater depth dose, factors which are indeed necessary to the destruction of the larger and more deep-seated lesions.

In an article published by Pfahler and Vastine (11), it is stated that there is more danger of recurrence when soft rays are used. Merritt and Rathbone (8) say that light filtration results in residual malignancy in the base of lesions involving cartilage, or in trophic ulceration. Pfahler and Vastine advised electrothermic surgery in such lesions, but Merritt and Rathbone maintain that such surgery will result in extensive scarring and, therefore, advise high kilovoltage and heavier filtration (220 kv.p. and 2 mm. of copper, plus 1 mm. of aluminum, which was found to have half value layer of 2.06 mm. of copper). They advise dosages ranging from 6,000 r for lesions as small as 1 cm. to 3 cm. in diameter, down to 4,500 r for lesions measuring 10 cm. to 15 cm. in diameter. The daily dosage is 350 r for smaller lesions and 200 r for the larger ones. They observe that with this method one obtains a different skin and subcutaneous reaction, so that the lethal threshold between skin and dermis is widened.

Fig. 1. J. K., aged 65 years. Basal-cell carcinoma of forehead present for three years. Treated with 6,046 r between Feb. 28 and March 10, 1939. First three treatments consisted of 784 r each, using 145 kv.p., 45 cm. distance, 0.5 mm. Al, followed by five treatments of 470 r each, same kilovoltage, 52 cm. distance, and 4 mm. Al filtration. Series completed with two treatments of 672 r each, employing 90 kv.p., 35 cm. distance, and 1 mm. Al.

Fig. 2. J. Y., aged 62 years. Bowen's disease. Five squamous-cell carcinomas of face, the largest measuring 2 × 1.5 cm. Each lesion given 6,050 r between Feb. 15 and March 10, 1939. A new lesion at medial canthus left eye was given 5,544 r from May 4 to 9. About July 12, a seventh lesion was developing on the tragus of the left ear, and this received 6,020 r between July 17 and 26. There is now (Aug. 12, 1939) complete primary regression of all lesions except the last one treated.

In his paper on "Advanced Cancer of the Head and Neck," C. L. Martin (7) states that the heavier the filtration the same total dosage. He uses 132 kv.p. for carcinoma of the lip even though the lesion is very superficial. He states, however,

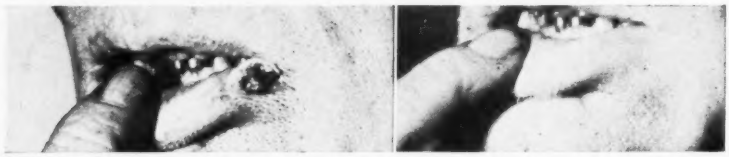

Fig. 3. W. L. T., aged 63 years. Squamous-cell carcinoma of the lip, Grade 1, two and one-half years' duration. Treated with 1,033 mg.-hr. surface radium in three divided doses between Dec. 3 and Dec. 6, 1937. No evidence of recurrence to date.

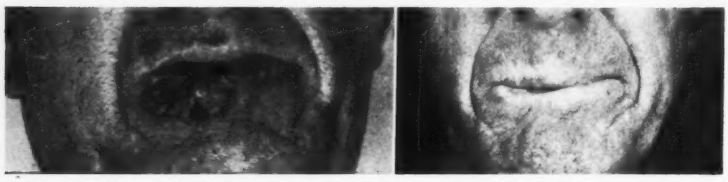

Fig. 4. T. B., aged 55 years. Squamous-cell carcinoma of the lip, Grade 1, 18 months' duration. Treated with 1,337 mg.-hr. of interstitial radium between June 19 and 23, 1938. Patient removed two needles the second night. X-ray therapy started Aug. 11 because of residual involvement, administering 3,890 r in one week. There was incomplete regression and the patient was given another series of x-ray treatments, administering 5,040 r between March 30 and April 5, 1939. At the present time there is no evidence of active carcinoma.

better the results. He has used dosages ranging from 4,200 r for lesions 7 cm. in diameter to 3,000 r for lesions 15 cm. in diameter, with satisfactory results. He reports good results in advanced lesions of the head and neck with the use of interstitial radium followed by x-ray, giving approximately 100 mg.-hr. per c.c. of involved tissue, and following it with 300 r daily doses of 220 kv.p. x-radiation for a total of 2,100 r, using filtration of either 2 mm. of copper or medium Thoraeus (3.5 mm. copper equivalent).

Howes (5) states that the longer wave lengths should be used for the superficial lesions because damage to deeper structures is thus avoided. He uses 100 kv.p., filtration 0.5 cm. of wood, and a distance of 50 cm., for a total dose of 4,500 r, given in either one sitting or on two successive days. For deeper lesions he uses 132 kv.p., filtration 0.5 cm. of wood and 1 mm. of aluminum and the same distance for the that carcinoma of the scalp, malignant melanotic lesions, squamous-cell carcinoma of extremities, and carcinoma in a scar are resistant to such treatment. He states that B. P. Widmann has used as high as 35 threshold erythemas on such resistant lesions. Pfahler and Vastine concur in these observations and our experience also verifies them.

Dresser and Dumas (1) favor higher voltage because of more uniform dosage. For lesions 1 cm. or more in thickness they advocate 200 kv.p., 0.5 mm. of copper filtration, and 30 to 50 cm. distance, depending on thickness. For lesions up to 2.5 cm. in diameter they apply what they term "massive technic," which consists of 600 r daily up to 4,000 r. For superficial lesions they sometimes give from 5 to 10 erythemas in one sitting, but they do not state whether they are threshold or full erythema doses. For the larger lesions (above 2.5 cm. in diameter) they give 300

r to 400 r daily. The irradiation of very large lesions is often protracted over a period of from two to three months, with total dosages as high as 8,000 r. They state that the optimum dosage given in a period of two weeks or less is from 2,400 r to 3,200 r. If this means that the average lesion can be cured by that dose, it is not in agreement with reports from other large clinics or with our findings.

Pendergrass (10) believes that the Chaoul technic is the treatment of choice for small superficial lesions in which short treatments are desirable. It is not suitable for larger, deep lesions because of marked radial variation of the radiation and rapid decrease in depth dose. The treatment factors consist of 45 kv.p., 4 ma., 0.2 mm. nickel filtration, having a half value layer of 2.4 mm. of aluminum. Three different distances are used, namely, contact, 3 cm., and 5 cm. The daily dose is from 300 r to 400 r for a total of from 6,000 r to 10,000 r.

MacComb (6), describing the technic used at Memorial Hospital, New York City, on 50 superficial skin lesions of the face, 46 of which were basal and four squamous, points out that the smaller the lesion the larger the dose necessary for complete regression. A lesion 5 cm. in diameter requires 3,500 r, while a lesion 1 cm. in diameter requires 6,000 r. The entire dose is given in one sitting. The technic used in this series was 100 kv.p., 5 ma., 30 cm. target–skin distance without filter, having a half value layer of 0.03 copper or 1 mm. of aluminum. When the thickness of the lesion exceeded from 3 mm. to 4 mm., the external portion was removed by actual cautery before the radiation was given, reducing its level to that of the skin surface. He states that it is necessary to relate the therapeutic dose to some biologic unit. This seems unnecessary to us and possibly misleading, for the reason that the values given by various observers for the erythema, as MacComb points out, vary anywhere from 300 r to 700 r. Authors sometimes refer to erythema dose without specifying threshold or full erythema, or how many r units they consider the erythema. We feel that considerable confusion could be avoided by stating dosage in r units, measured in air, because this method is fairly accurate and its use generally understood among therapists truly interested in curing carcinoma of the skin.

J. R. Driver (2), reporting on 324 lesions involving canthi and eyelids, had 19, or 6.5 per cent, failures, including six deaths. He ascribes the causes of his failures to the following factors:

1. Inadequate previous treatment. Of the total series, 25 per cent had received inadequate previous treatment by various methods: 50 per cent of the failures occurred in this group.
2. Insufficient dosage (3,200 r to 6,000 r). Too close screening is a factor here.
3. Extensive involvement.
4. Radioresistance.

We feel that the latter should be included under insufficient dosage because we do not believe this is a factor in itself with reference to basal- and squamous-cell carcinomas of the skin.

Our treatment technic was governed by type, thickness, and diameter of the lesion. Biopsies were taken on all cases with the exception of the earliest ones treated. Photographs were made first in the majority of cases. The superficial basal-cell lesions were treated with 90 kv.p., 5 ma., 35 cm. target–skin distance without filter (half value layer 0.6 mm. aluminum) to 1,000 r (and sometimes 2,000 r), and filtering through 1 mm. aluminum (half value layer 1.2 mm. aluminum) for the remainder of the dose. For the thicker basal-cell lesions, the intradermal, the adenocystic, and the squamous-cell lesions, we employed various combinations of 145 kv.p. at 45 cm. distance (Oddman cone), 200 kv.p. at 52 cm. distance, and filtrations of 0.5 mm. aluminum, 4 mm. aluminum, 0.25 mm. copper, 0.5 mm. copper, and 2 mm. copper. The half value layer of 145 kv.p. at 45 cm. distance and 0.5 mm. aluminum filtration is 6.25 mm. aluminum, and the half values for 200 kv.p., 18 ma., 52 cm. distance, 0.5 mm. and 2 mm. copper, are

1.18 mm. and 2.12 mm. copper, respectively. We have attempted to deliver the entire dose within two weeks, most cases requiring seven days. For lesions measuring up to 3 cm. in diameter we gave from 600 r to 1,000 r per treatment, treating every day except Sundays. For lesions more than 3 cm. in diameter, from 200 r to 400 r were given daily, using the smaller dose for the largest lesions. We have given as large a dose for the 3 cm. lesions as for the 0.5 cm. lesions. Our total dosage in those cases of the entire group which showed complete regression by the first series, varied from 3,038 r to 6,218 r, except the one lesion which we considered completely removed by biopsy and which received only 2,004 r. From our results the opt mum dosage for the basal-cell group appears to be from 4,000 r to 6,000 r, while for the squamous-cell group it is from 5,500 r to 6,500 r.

The surface radium technic consisted in the use of 0.2 mm. platinum cells 11 mm. in length, containing 3.3 or 1.3 mg. of radium within silver capsules 1.6 mm. in thickness, and 0.5 cm. balsam wood. Using this technic it requires about 205 mg.-hr. to deliver one full erythema. The total dosage varied from 90 mg.-hr. to 1,033 mg.-hr The lesion which showed complete primary regression by 90 mg.-hr. was a minute lesion on the nose, considered to be completely removed by biopsy. The great variation in the dosage was predicated upon great differences in thickness and surface area of the lesions treated. We now consider this contrary to the principles of good radiation therapy. We very seldom use surface radium at the present time, because of the length of time required for such treatment.

Discussion of Tables I and II.—All cases included in the tables had a biopsy satisfactory for diagnosis. All superficial basal-cell carcinomas which received more than 4,000 r at the first series of treatments showed complete primary regression. About from six to twelve weeks were allowed in all cases for primary regression to take place. Of the cases receiving between 3,000 r and 4,000 r, three, or 33 1/3 per cent, resulted in incomplete regression. The one lesion receiving only 2,004 r, as previously stated, was completely removed by biopsy. It measured only 2 mm. in diameter. It is noted that those lesions requiring additional treatment required much larger total doses for complete regression than those destroyed by the first series. The first case listed in Table II has received 14,987 r and is still under observation. The patient had some cartilage involvement (Fig. 7) when first seen, and, at present, the lesion appears to be extending into the external auditory canal. The second and third lesions listed in Table II received 11,634 r and 8,648.8 r, respectively, before apparent complete regression took place. The only explanation we have to offer for the complete regression obtained in the last three cases listed in Table I is that they were completely removed by the biopsy. Of the 68 lesions biopsied, 40 per cent represented basal-cell carcinoma and 60 per cent squamous-cell. There were two intradermal and one adenocystic basal-cell lesions.

Discussion of Tables III and IV.—All squamous-cell carcinomas which received more than the total dose of 5,500 r at the first series of treatments showed complete primary regression. One case out of four, receiving between 5,000 r and 5,500 r

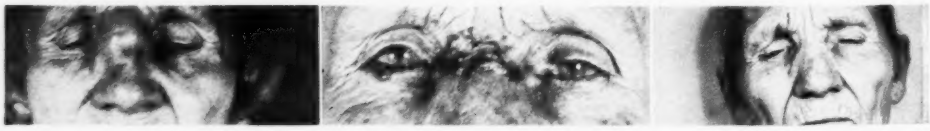

Fig. 5. S. F., aged 69 years. Basal-cell carcinoma, adenocystic type, of three years' duration. Treatment consisted of 6,090 r x-radiation, employing 200 kv.p., 0.25 mm. Cu, 0.5 mm. Al, 45 cm. distance, delivered between Feb. 13 and 23, 1939. Complete primary regression. There is now no evidence whatever of the lesion, not even residual scarring. Photographs show appearance before treatment, one month and five months after completion of treatment.

(Case 1, Table IV), showed incomplete primary regression. The lesion involved the anterior wall of the external auditory canal and undoubtedly involved cartilage. Fifty per cent (three out of six) of the cases receiving between 4,000 r and 5,000 r incompletely regressed. The two cases receiving less than 4,000 r at the first series required additional treatment. There are four cases in this group which showed complete primary regression by small doses of radium, and we believe the biopsy specimen represented the entire lesion. Several of the entire series involved cartilage and many were very extensive.

TABLE I.—BASAL-CELL CARCINOMA OF SKIN SHOWING COMPLETE REGRESSION AS A RESULT OF FIRST TREATMENT SERIES

	Location	Dose	Date of Treatment
1.	Nose	6,090 r	2-13-39 to 2-23-39
2.	Cheek	6,050 r	6-21-39 to 7- 1-39
3.	Forehead	6,046 r	2-28-39 to 3-10-39
4.	Face	5,900 r	2- 7-38 to 2-10-38
5.	Left thorax	5,144 r	12-21-38 to 12-30-38
6.	Upper lip	4,890 r	8-24-38 to 8-31-38
7.	Left ear	4,572 r	11-15-38 to 11-21-38
8.	Temple	4,356 r	4-25-39 to 4-27-39
9.	Ear	4,135 r	6-14-38 to 6-21-38
10.	Neck	4,067 r	1-30-39 to 2- 2-39
11.	Neck	3,996 r	11- 4-38 to 11-10-38
12.	Web of fingers	3,512 r	8-31-38 to 9- 6-38
13.	Nose	3,366 r	9-30-38 to 10- 4-38
14.	Upper lip	3,156 r	10-10-38 to 10-15-38
15.	Below left ear	3,048 r	6-14-38 to 6-22-38
16.	Nose	3,038 r	4- 3-39 to 4- 5-39
17.	Nose	2,004 r	8-25-38 to 8-26-38
18.	Cheek	900 mg.-hr.	9-20-37 to 9-21-37
19.	Temple	399 mg.-hr.	8-31-37 to 9- 2-37
20.	Neck	300 mg.-hr.	5-18-38
21.	Nose	280 mg.-hr.	10- 4-37

TABLE II.—BASAL-CELL CARCINOMA OF SKIN REQUIRING MORE THAN ONE TREATMENT SERIES FOR COMPLETE REGRESSION

	Location	First Series	Date of First Series	Additional Treatment	Total
1.	Ear	3,872 r	10-24-38 to 10-28-38	11,115 r (see Fig. 7)	14,987 r
2.	Nose	3,864 r	6- 9-38 to 6-28-38	7,770 r	11,634 r
3.	Cheek	3,060 r	9-20-38 to 9-23-38	5,588.8 r (see Fig. 6)	8,648.8 r
4.	Cheek	1,980 r	8- 8-38 to 8-11-38	1,144 r	3,124 r
5.	Forehead	540 mg.-hr.	9- 3-37	673.2 mg.-hr.	1,213.2 mg.-hr.
6	Nose	294 mg.-hr.	4-28-38	7,052 r	294 mg.-hr. 7,052 r

Discussion of Failures.—Six of the cases requiring additional treatment must be considered complete failures, to date, from the standpoint of radiation therapy. We believe the radiation administered in Case 5, Table IV, contributed to the patient's death. He came to us from the Venereal Disease Clinic with a granulomatous involvement of most of the penis and bilateral inguinal adenopathy with ulceration on the left side. The blood Wassermann was positive but the lesion did not regress under antisyphilitic treatment. The ulcer was of many months' duration and biopsy from its edges was reported as squamous-cell carcinoma. This ulcer extended upward on the abdominal wall a distance of about fifteen centimeters: it was about nine centimeters in width. Our irradiation was followed by a slough of the abdominal wall down to the peritoneal surface. We probably administered the radiation too rapidly to such a large area. The edges of the ulcer progressed and the patient died on March 24, 1939, of peritonitis. Bacteriologic investigation of mate-

rial from the ulcer failed to disclose anything of significance. While we may have been dealing primarily with a venereal disease, with or without phagedenic ulcer, the irradiation given appeared to precipitate the patient's final decline.

Fig. 6.

Fig. 7.

Fig. 6. W. S., aged 64 years. Complete regression of an intradermal basal-cell carcinoma eight months after completion of treatment. Received x-radiation as follows: 3,060 r of 90 kv.p., 1 mm. Al filtration, and 588 r of 145 kv.p., 4 mm. Al filtration between Sept. 20 and Oct. 4, 1938. A second series became necessary and this consisted of 5,000 r of 200 kv.p., 0.25 mm. Cu, 0.5 mm. Al, delivered between Nov. 28 and Dec. 6, 1938. Total radiation represented about 22 threshold erythemas. This lesion should have received at least 5,000 r at first series.

Fig. 7. F. K., aged 69 years. Basal-cell carcinoma of the entire auricle. Given 3,872 r x-radiation from Oct. 24 to 28, 1938. Residual activity noted Dec. 14, and an additional 2,050 r was delivered. Treated again Feb. 1 to 6, 1939, with 3,136 r. Did not return until July 12, 1939, at which time he had extensive recurrence involving one-half of the auricle with extension into the auditory canal as shown. Completed a third series Aug. 5, employing 200 kv.p., 2 mm. Cu, 0.5 mm. Al, 52 cm. distance for a total of 6,000 r. Improper primary treatment.

The lesions in Cases 9 and 12,[2] Table IV, were first removed surgically and had recurred at the operative site when first seen in our Clinic. One finally came to amputation of the medial third of the carpus, together with the fourth and fifth digits, and the patient is now apparently entirely well. The other has a large denuded surface at the site of the removal of the ear, with complete exposure of the mastoid process. The disease has extended along the auditory canal medially and there is definite disturbance of equilibrium at the present time. There is very little pain, however.

Case 6, Table IV, had several different lesions of the skin of the face and neck treated by different methods over a period of 12 years. He had two lesions on the left side of the neck when first seen in our Clinic. One of these lesions had been previously treated by radium and that is the one which metastasized to regional lymph glands. The lesion was infected. At the time interstitial radium was implanted several biopsies were taken from regional glands and from surrounding areas which appeared to be invaded, but all sections were negative for carcinoma. The patient had considerable pain in the side of the neck and behind the ear, and seemed to be declining although we could see or feel no evidence of active carcinoma. An area 3 by 5 cm. in size failed to cover by granulation, and after two months it was decided, in consultation with the plastic surgeon, to remove the scar and graft, in the hope of relieving the pain and obtaining complete granulation. The patient died from hemorrhage two days after the operation

Case 1, Table IV, had his lesion at the tragus of the ear. It had been present for three years and involved cartilage for a

[2] Case 12, Table IV, has died since submission of this paper for publication.

depth of at least 1.5 cm. We feel that our primary treatment was inadequate for the destruction of a lesion involving cartilage. Case 7, Table IV, presented, on admission, a thick and deep lesion, 3 by 4 cm. in size, behind the ear. Radium needles were used, followed later by x-ray. We last saw the patient in December, 1938, at which time there was a residual open infected area over a surface of 3 by 4 cm. We have assigned the failure to improper spacing of needles.

There were 15 cases treated without biopsy when our therapy equipment was

TABLE III.—SQUAMOUS-CELL CARCINOMA OF SKIN SHOWING COMPLETE REGRESSION AS A RESULT OF FIRST TREATMENT SERIES

	Location	Dose	Date of Treatment
1.	Nose	6,218 r	12-27-38 to 1-12-39
2.	Lip	6,170 r	2-21-39 to 3- 2-39
3.	Lip	6,122.8 r	11-21-38 to 12- 2-38
4.	Temple	6,118 r	6-26-39 to 7- 6-39
5.	Right lower lid	6,060 r	2-15-39 to 3-10-39
6.	Left external canthus	6,060 r	2-14-39 to 3-10-39
7.	Nose	6,056 r	2-15-39 to 3-10-39
8.	Lip	6,048 r	3- 6-39 to 3-15-39
9.	Ear	6,039 r	2-15-39 to 3-10-39
10.	Nose	6,039 r	2-15-39 to 3-10-39
11.	Ear	5,990 r	6-13-39 to 6-28-39
12.	Neck	5,648 r	12-16-38 to 12-24-38
13.	Neck	5,648 r	12-16-38 to 12-24-38
14.	Left medial canthus	5,544 r	5- 4-39 to 5- 9-39
15.	Ear	5,240 r	1-26-38 to 2- 5-38
16.	Lip	5,120 r	8-30-38 to 9- 7-38
17.	Ear	5,087.8 r	8- 2-38 to 8-10-38
18.	Lip	4,980 r	2- 2-39 to 2- 9-39
19.	Lip	4,601 r	7-22-38 to 8- 2-38
20.	Nose	4,268 r	1- 4-39 to 1-11-39
21.	Neck	4,171 r	9-30-38 to 10- 5-38
22.	Lip	1,033 mg.-hr.	12- 3-37 to 12- 6-37
23.	Nose	630 mg.-hr. and 2,046 r	7-28-38 to 8- 5-38
24.	Nose	446 mg.-hr.	9- 2-37 to 9- 4-37
25.	Lip	294.5 mg.-hr.	6- 7-38 to 6-10-38
26.	Left medial canthus	240 mg.-hr.	11-10-37
27.	Nose	90 mg.-hr.	5- 5-38

TABLE IV.—SQUAMOUS-CELL CARCINOMA REQUIRING ADDITIONAL TREATMENT

	Location	Dose	Date of Treatment	Additional Treatment	Total
1.	Ear	5,058 r	8-27-38 to 9- 6-38	7,394 r	12,452 r
2.	Neck	4,432 r	9-30-38 to 10- 5-38	3,032 r	7,464 r
3.	Ear	4,198 r	2-15-38 to 2-17-38	210 mg.-hr.	4,198 r 210 mg.-hr.
4.	Ear	4,020 r	5-27-38 to 6-30-38	2,014 r	6,034 r
5.	Abdomen	3,981 r	9-21-38 to 9-24-38	2,354 r	6,335 r
6.	Neck	2,688 r	8- 9-38 to 8-12-38	11,144 r 601 mg.-hr.-surface; 3,168.4 mg.-hr.; 2,567.4 mg.-hr.-interstitial (11 needles)	13,832 r
7.	Neck	600 r 2,098.4 mg.-hr. (8 needles)	6- 4-38 6-15-38 to 6-18-38	10,103 r	10,703 r 2,098.4 mg.-hr.
8.	Lower lip	1,337.4 mg.-hr.	6-18-38 to 6-23-38	8,930 r	1,337.4 mg.-hr. 8,930 r
9.	Hand	730 mg.-hr.	9- 7-37 to 9- 8-37	300 mg.-hr. 6,245 r	930 mg.-hr. 6,245 r
10.	Neck	420 mg.-hr.	1- 4-38	4,440 r	420 mg.-hr. 4,440 r
11.	Nose	360 mg.-hr.	9-25-37	240 mg -hr.	600 mg.-hr.
12.	Ear	300 mg.-hr.	9-11-37	210 mg.-hr. 14,606 r	510 mg.-hr. 14,606 r
13.	Neck	Unknown (treated elsewhere)	1937	3,538 r	3,538 r
14.	Neck	240 mg.-hr.	5-24-38	2,956 r	240 mg.-hr. 2,956 r

first installed. All of these except one showed primary regression and have not shown recurrence to date. These cases have been followed two years since treatment. The one case in which regression was incomplete had had previous treatment of various types over a period of twelve or fifteen years. She still has a small lesion at the margin of the scar which involves both canthi, glabella, and surrounding skin to a vertical diameter of 5 cm. This has the appearance of a trophic ulcer which is, however, not moist, and may eventually granulate.[3] The recurrence, we believe, was due to too close screening of surrounding tissue. It is common knowledge that the non-biopsied small lesions show less scarring after regression is complete than those which are biopsied.

CONCLUSIONS

1. Basal-cell carcinoma of the skin should receive at least 4,000 r and preferably 5,000 r of low voltage (90 to 130 kv.p.) x-ray therapy, using a combination of no filtration and 1 mm. aluminum filtration at the first treatment or at the first series of treatments.

2. Intradermal, adenocystic, infiltrating basal-cell and squamous-cell lesions should receive between 5,500 r and 6,500 r, using medium and high voltage x-ray and from 0.5 mm. aluminum to 2 mm. copper filtration, and giving about 200 r daily. Small lesions may be given large daily doses (1,000 r the first day and 600 r daily thereafter).

3. Temporizing and injudicious treatment are to be condemned because, in the great majority of such instances, a simple treatment problem is converted into a long-drawn, difficult one which may terminate in a fatality.

[3] At the time of proof-reading (6–12–40) lesion had been completely healed for nine months.

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OCULAR HYPERTELORISM WITH CLEFT PALATE AND GIANT-CELL TUMOR[1,2]

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OCULAR hypertelorism (υπερ, too much; τηλε, apart; οριδω, to separate) as an entity was first described by Grieg (1), in 1924, who presented a complete clinical and pathologic picture. Our review of the literature regarding this developmental, congenital condition reveals that less than thirty cases have been reported to date.

Etiologically little is known of this condition. Abernethy (2) and Braithwaite (3) suggest an endocrine basis. Abernethy also made an interesting observation in regard to the hereditary aspect and states:

"The shape of the sphenoid, like the number of digits, may be developmentally one of the 'weak' spots which, though normally fixed, are more liable to extra-normal variation, whether advantageous or disadvantageous to their possessors, than the other members of the body."

Grieg (1) in his original article remarked:

"In this anomaly about the third month of fetal life the lesser wings increase greatly in width, so much so that they may be equal to, or even greater than, the greater sphenoidal wings. The lesser wings of the sphenoid form the posterior part of the roof of the orbit. Thus, due to the enlargement and premature ossification of the lesser wings, the fetal lateral deviation of the orbit remains fixed."

Ogilvie and Posel (4) also account for the peculiar facies thus:

"An enlargement of this wing . . . pushes the whole frontal and maxillary bones upward, forward, and outward. An internasal bone is thus necessary and a retroussé nose develops. The tilting of the frontal bone . . . explains the combination of low forehead with slight prominence of the frontal eminences."

Reilly (5) comments on the fact that additional deformities and stigmas may be found, such as high palates, syndactylism, and undescended testes.

The clinical characteristics are:

(*A*) Comparatively large skull with the vertex flattened and a small face (brachycephalic skull).

(*B*) Wide spaced orbits with the horizontal axes of the eyes directed more laterally than normal.

(*C*) The bridge of the nose widened and flattened, with a retroussé nose.

(*D*) Mental deficiency usually although the individual may have normal intelligence.

Although hypertelorism as an entity is largely of academic interest, in view of the paucity of cases reported with coexisting congenital anomalies and no previous mention of associated cleft plate and giant-cell tumor, we feel that the case reported here should be added to the literature.

G. M., aged four years, was admitted to the hospital on Jan. 27, 1938, with chief complaint of painful micturition and marked dysuria of one week's duration. There was no gross bloody urine but the color of the urine was dark. There was no frequency, vomiting, chills, or fever.

Past History.—The child was a full term, non-instrumental delivery. Labor had been very difficult, lasting three days. The child was born with the cord around the neck and asphyxia was present. Cleft palate and harelip were noted at birth. His weight at birth was eight pounds. Childhood illnesses consisted of varicella and parotitis.

Development.—Feeding was difficult due to inability to nurse well. He held his head up at three months, and sat up at seven months. Teeth began to appear at six months. The child did not walk, and

[1] From the Department of Pediatrics, New York Post-graduate Medical School and Hospital, A. G. DeSanctis, M.D., Director; Service of M. C. Pease, M.D., and the Department of Radiology, New York Post-graduate Medical School and Hospital, William H. Meyer, M.D., Director.

[2] Accepted for publication in March, 1939.

at twelve months the mother noted that he had difficulty moving his legs.

Family History.—One other sibling is living and well; one sibling died at the age of three months with heart disease. No other positive data.

Previous hospital admissions included one in 1936 with diagnoses of:

(*a*) cerebral birth palsy (Little's disease);
(*b*) congenital cleft palate (complete) repaired at this time;
(*c*) congenital harelip, repaired at this time, and
(*d*) congenital nystagmus.

In 1937 he was admitted for bilateral tenotomy of subcutaneous adductor tendons of hips and tendo achillis for spastic paraplegia.

Physical Examination.—This revealed an apprehensive four-year-old boy with repaired harelip and prominent eyes, who did not appear to be acutely ill. Mentality seemed below average normal. His skin was mostly clear, with no gross abnormality observed.

His head was flattened anteroposteriorly and the occiput was flat. The entire head appeared box-shaped. The hair was of normal texture. The external skull measurements were: circumference, 452 cm.; occipito-frontal diameter, 14.25 cm.; biparietal diameter, 13.4 cm.; frontal to inion, 15.25 cm., and glabella to inion, 14.5 cm.

The ears showed the landmarks to be bilaterally visible; no abnormality noted; no obliteration of light reflex.

Examination of the eyes (consultation of Dr. Harold Brown) revealed rotary nystagmus with no evidence of paralysis of extraocular muscles. The cornea and conjunctiva showed no congenital anomalies. The pupils were regular and equal and reacted to light and accommodation. The iris and lens were normal. Tension by palpation was normal. Fields by confirmation were normal. The fundi were normal. O.S., diverging. O.D., 6/20; O.S., 6/50. Exophthalmic reading, 20 O.U. Interpupillary distance, 62 mm.

The nose showed a moderate deviation of the septum to the right with only slight occlusion of the nasal passage on the right.

The mouth revealed a repaired harelip and cleft palate; good function. The tongue was slightly coated but normal. The teeth were deciduous and showed

Fig. 1.

Fig. 2.

caries of moderate degree and poor dentition. The tonsils were enlarged but not inflamed. The neck showed no adenopathy or rigidity; no abnormality.

There were no external deformities in the chest and musculature was normal. The lungs were clear to auscultation and percussion. The heart was not enlarged, and the tones were of good quality and rhythm; no murmurs.

In the abdomen no masses were palpated nor was any tenderness or spasticity elicited. There was no costo-vertebral tenderness. No abnormality of penis, scrotum, or testicles was noted.

Examination of the extremities revealed both legs in braces, and post-operative scars were present over both thighs. Musculature was poor and flabby. Knee jerks were not done, but other reflexes were physiologic.

The hospital course was 29 days during which time the patient was entirely afebrile. Repeated urinalyses were consistently negative.

A preliminary roentgen-ray examination of the abdomen on Jan. 29, 1938, before intravenous urography, accidentally revealed a "cystic osteo-fibromatous invasion (giant-cell tumor) of the upper end of the shaft and trochanter of the right femur. There was no evidence of lithiasis." On Feb. 9, 1938, another intravenous urogram was attempted but revealed no gross abnormality An incomplete pathologic fracture, however, was discovered through the giant-cell tumor, mainly on the mesial aspect of the right femur.

During the entire hospital stay, the child voided with no difficulty and, although closely observed for complaint of pain, this was volunteered only on three occasions, and in each instance associated with brace application.

Therapy consisted of application of a plaster spica of the right hip and x-ray fractional cumulative treatment to the giant-cell tumor.

While in the hospital, it was noted that, in addition to the exophthalmic-like prominence and nystagmus of the eyes, there was also abnormal widening of the orbits and, for this reason, an x-ray examination of the skull was made and an eye consultation requested.

Roentgenographic examination of the skull revealed no gross abnormality in regard to position, detail, or outline of the bones of the vault or base. The sella turcica was small, about 20 per cent below average normal. There was wide spacing between the orbits with the small wings of the sphenoids markedly enlarged. This was probably congenital in origin. A deviation of the septum to the right was observed, with partial occlusion of the nares on that side. Imperfect dentition also existed. The convolutional markings in the occipital region were a shade accentuated. Cephalic index, 100.3.

Comment.—An interesting problem is presented by this association of cleft palate and abnormal size of the lesser sphenoidal wings. There are many cases of cleft palate that clinically present the findings of apparently widely separated orbits but which are radiographically within normal limits.

Only in the entity as originally described by Grieg should the term "ocular hypertelorism" be applied and this should be verified by roentgen examination.

The finding of the giant-cell tumor was purely accidental and incidental to the hypertelorism.

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CASE REPORTS AND NEW DEVICES

CONGENITAL MALFORMATION OF THE TRANSVERSE PROCESSES OF THE FIRST DORSAL VERTEBRA[1,2]

By ANTONIO MAYORAL, M.D., *New Orleans, Louisiana*

Chief of the X-ray Department, United States Marine Hospital, and Assistant Professor of Radiology, Tulane University

Several years ago, the United States Employees Compensation Commission referred to us a claimant who had been receiving compensation for about two years because of an ununited fracture of the right transverse process of the first dorsal vertebra, requesting that we determine the amount of his present disability.

History.—On Feb. 7, 1929, while working as a laborer on a Government project, the patient had lifted a hammer to cut rivets, at which time he felt something snap in his right shoulder and a "hot streak" run down his shoulder and back. No immediate disability followed and he continued work for several days after the "injury," complaining for the first time when he was laid off.

The patient was first seen by a physician on March 20, 1929, who evidently did not believe the injury severe enough to warrant an x-ray examination. The complaints continued and the patient was then sent to another physician who, on June 5, 1929, had a roentgenograph made of the shoulder, from which the diagnosis of a fracture of the right transverse process of the first dorsal was made.

The patient's complaints at the time of his admission were the same as those that immediately followed the alleged injury; they had not improved. A roentgenograph made by us at admission (Fig. 1) showed the condition to be the same as that reported on the previous film, that is, an ununited fracture. Examination of the patient revealed no tenderness in the shoulder or neck, no limitation of motion. When caught unaware, he acted normally; however, when questioned, he said his pain was unimproved.

There is no question as to the solution of continuity of the right transverse process of the first dorsal vertebra. The well rounded edges of the bone at the line of cleavage left no doubt, however, that the condition dealt with was an old one. Such findings, seen in a roentgenograph taken immediately after an injury, are conclusive, but in this case the cleavage could not be mistaken for a recent fracture.

The most recent roentgenograph in our case, however, was made almost four months after the alleged injury. The diagnosis of non-united fracture was feasible, but I did not accept it, basing my refusal on three facts: first, isolated fractures of the transverse process of the first dorsal vertebra are rare; second, the history of injury to this patient was very doubtful, and, if he had had an injury, surely it had not been severe, and third, in the roentgenograph the cleavage called "fracture" is quite similar to the congenital non-union of the transverse process of the first lumbar vertebra with which we are so familiar.

I made the diagnosis of congenital non-union of the transverse process of the first dorsal vertebra and this diagnosis was accepted. The

[1] Accepted for publication in March, 1939.

[2] Published with the permission of the Surgeon-General of the United States Public Health Service.

Fig. 1.

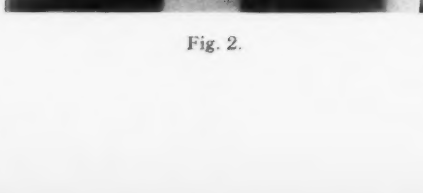

Fig. 2.

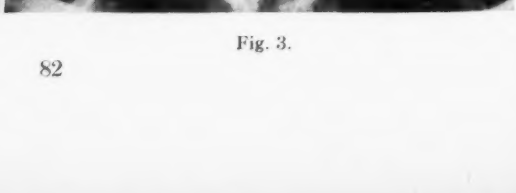

Fig. 3.

Fig. 4.

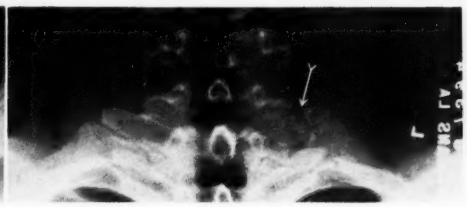

Fig. 5.

compensation the patient was receiving was stopped, and the case closed.

To prove my conclusions, however, I made an extensive and thorough search of the medical literature but found no similar cases to support my contention. I did find, however, in the fourth edition of Grashey's Atlas the statement that sometimes an extra nucleus exists, for the transverse process of the first dorsal vertebra.

Finding no aid from the usual sources, our films were studied and all the roentgenographs which had been taken in our hospital between 1930 and 1934, inclusive, in which the first dorsal vertebra was shown, were carefully examined. These totaled 5,632. My efforts were rewarded with the finding of four additional cases of non-union of the transverse process of the first dorsal vertebra—two bilateral and two of the left process. None of the cases had suffered an injury, and all of the roentgenographs had been made because of suspected chest pathology. We have, therefore, four cases (Figs. 2, 3, 4, and 5) showing cleavage of one or both transverse processes of the first dorsal vertebra, in which trauma past or present can be absolutely ruled out. My figures indicate that non-union of the transverse process of the first dorsal vertebra may be expected once in about every 1,126 individuals examined.

In looking for an explanation of the condition, one must necessarily revert to the ossification of the vertebræ. This begins in intrauterine life from three primary nuclei, one for the body and one each for the arches. In addition, there are five supplementary centers, one for the spinous process, one for each transverse process, and one for each of the superior and inferior cartilaginous discs of the body. These last centers appear at puberty and are completely united between the ages of 25 and 30 years.

The centers for the arches grow forward to join the body and backward and inward to close the neural canal, thence forming the spinous processes. Midway on either side a sprout is given off to form the transverse processes. One of three things may happen during ossification of the vertebræ to explain the malformation described herein. First, failure of growth of that part of the nucleus that goes to form the transverse process, the secondary nuclei making an abnormal growth to correct the deficiency; but never effecting a complete bony union. Second, the development of an extra nucleus for the process, the two nuclei never uniting. Third, cleavage of the primary nucleus where the transverse process is given off, reunion never being effected.

I have offered casuistic as well as embryologic support for my contention that occasionally either or both of the transverse processes of the first dorsal vertebra may remain ununited. Judging by the relative frequency with which I have found this condition in chest roentgenographs, I feel that other roentgenologists must be familiar with it, but have failed to give it due importance.

The necessity of recognizing congenital malformation, especially at present when compensable trauma is part of our daily routine, is emphasized by the case herein reported.

A CONVENIENT PHOTOGRAPHIC FILM MARKER[1]

By C. J. ATTWOOD, M.D., *Oakland, California*

From the Department of Radiology of the Samuel Merritt Hospital

Of the various methods used to label x-ray films, the photographing of the reduced image of a card bearing the patient's name, date, filing number of the film, and other pertinent data directly upon a small portion of the film shielded from previous x-ray exposure has many advantages. It is neat, permanent, and utilizes a minimum amount of film surface and permits, moreover, the recording of exposure factors directly upon the film so that if desired they may be readily duplicated at a second examination. Perhaps the greatest merit of this method of film identification, however, is the fact that it eliminates any possibility of confusion when

[1] Accepted for publication in September, 1939.

viewing wet films. There is no danger of confusing films of different patients undergoing similar examinations while films are mixed together in the washing tank or in drying racks, since the patient's name may be seen on the film from the time of development.

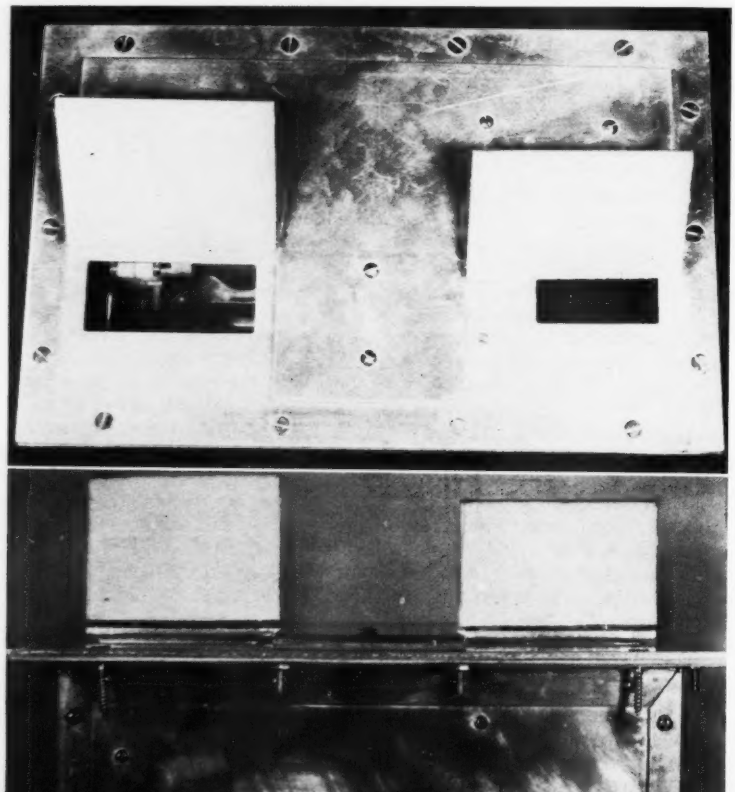

Fig. 1. Top view of labeller with doors open.
Fig. 2. Side view of labeller with doors open.

The device here described is the result of an attempt to design a film marker which would reduce photographic film labelling to the simplest possible procedure. As shown in Figures 1 and 2, it consists of a box with an overhanging top so that it may be set into the darkroom table or bench. The top being flush with the surface of the table or bench upon which the films are removed from cassettes, it is most economical of space. In the top are two doors, shown open in Figures 1 and 2. The labelling process consists simply of placing the card beneath the left-hand door and the corner of the exposed, undeveloped film shielded from previous x-ray exposure, under the right-hand door. By flashing on and off a light within the box by means of a foot switch the reduced image of the card is photographed upon the film.

The details of construction are shown in Figures 3 and 4. The box is made of sheet aluminum 3/32 inch thick and bound with 3/4-

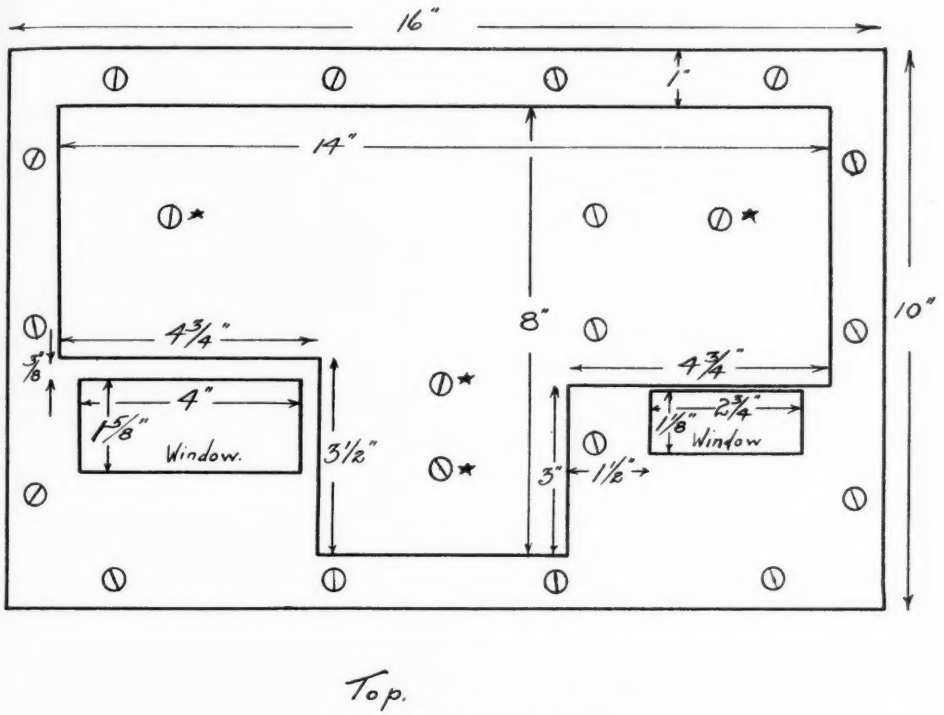

Fig. 3. Detail drawing of top.

inch angle brass. The top of the box overhangs the sides and ends 1 inch and is attached by means of bolts. It is made from two sheets of 3/16-inch aluminum held together by four bolts (marked ★ in Fig. 3). In the lower sheet are cut two windows; one on the left for the card and a smaller one on the right through which the image of the card is projected upon the film. Screws are provided at the corners for fastening the device to the darkroom table or bench.

As seen in Figure 4, the box is divided into two compartments by a lens plate secured by angle brass to the sides, top, and bottom. Within each compartment is a mirror set at an angle of 45 degrees to the lens plate. These mirrors are placed beneath the windows in the top and reflect the image of the card through the lens and up again through the small window on the right to the film. The inside of the compartment beneath the small film window is painted dull black. The mirror in this compartment may be conveniently mounted on a plate extending all the way across the compartment and secured to the sides by means of angle brass. The mirror in the larger compartment beneath the card window should be mounted on a plate extending only halfway across the box and secured to the side of the box on one side and to a brace from the bottom of the box on the other. In this way space is left to mount a light globe opposite the card window, thus securing a relatively even intensity of light upon the card. A door is provided at the back of the box through which the light globe may be replaced when necessary. An ordinary globe of 15 or 20 watts will be found sufficient to give a good exposure. It is, of course, also necessary to provide for plugging-in wires to the light globe. Since the box must be light-tight to prevent danger of fogging the film, the under surfaces of the doors are covered with heavy cloth or felt. It may be found necessary to solder the corners of the box, should light be found to leak through at the mitered ends of the angle brass.

The dimensions of the box and the size of the windows are obviously determined by the focal length of the lens used. Those given in Figures 3 and 4 were found to be correct for the lens used in the Eastman Home Enlarger. Whatever lens is used, however, it is absolutely necessary to determine experimentally the exact position for the mirrors and the lens before they are finally fixed in place. This is best done by using a temporary cardboard lens plate in which the position of the lens may be changed

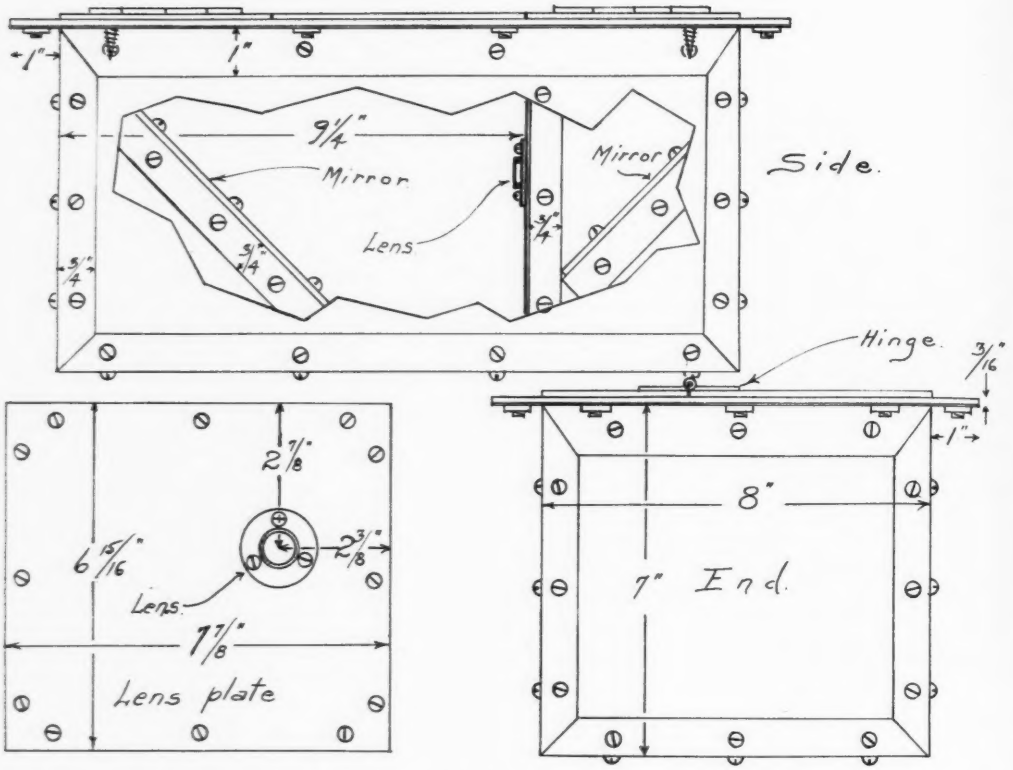

Fig. 4. Detail drawing of side, lens plate, and end. A portion of the side is drawn cut away to show position of the mirrors.

and which can be moved back and forth in the box until a sharp focus is obtained. A cardboard template of the top should be made by all means, so that the position and size of the windows are known to be exactly right before the permanent top is made. The importance of this careful checking of the position of the mirrors and lens and of the size and location of the windows in the top before their final construction cannot be too strongly emphasized. Only in this way can one be sure that a sharp image of the right size will be obtained on the film.

A method of shielding an area of the film from previous x-ray exposure that has proven satisfactory is simply to attach a piece of sheet lead to the face of the cassette with adhesive tape. It must be carefully placed to correspond to the area of the film exposed by the labeller. It is important, also, to place it on each cassette in the same corner with relation to the hinge on the back of the cassette. By doing this the shielded area of the film will be routinely placed in the labeller.

PERFORATION OF STOMACH DUE TO SYPHILIS

By HENRY G. HADLEY, M.D., *Washington, D. C.*

Syphilis of the stomach is fairly common. In a personal series of 1,000 gastro-intestinal x-ray examinations, 22 of which had a positive Wassermann reaction, or 2.2 per cent, two of this number, or 0.91 per cent, were found to have gastric lesions which were probably tertiary in character. One of these entirely disappeared with antisyphilitic treatment. Perforation of a syphilitic gumma, as in this case, is relatively rare. Especially rare is the oc-

[1] Accepted for publication in July, 1939.

currence of a perforation, as evidenced by x-ray examination in this case.

Case Report.—G. D., male, aged 54, first came under observation on May 21, 1939. The presenting symptoms were: loss of weight, gastric pain, and anemia. He had an evident pyloric obstruction, but because the blood

Fig. 1.

serum and the spinal fluid reactions were 4 plus, the possibility of the obstruction being due to syphilis was considered. X-ray examination showed the pylorus to be greatly deformed, with almost complete obstruction, and only a small amount of opaque mixture leaving the stomach. Gas was not found over the diaphragm, which was accounted for by the perforation being in the dependent part of a full stomach.

Perforation occurred on the afternoon of May 23, 1939, with classical symptoms. The operation was performed by Dr. O. C. Cox, in Garfield Hospital, immediately after.

At that time he found (1) a complete obstruction of the pylorus; (2) a large rent one inch in length in the gastric wall near the pylorus, and (3) a large amount of barium emulsion free in the abdominal cavity.

The perforation was repaired in the usual way and a posterior gastro-enterotomy performed. Recovery was uneventful, and at the present time the patient is gaining in weight and is back at work, continuing the antisyphilitic therapy.

A NEW METHOD FOR LOCALIZATION OF FOREIGN BODIES[1]

(ORTHODIAGRAPHIC METHOD)

By DR. ISMET SAYMAN, Radiologist, Military Hospital, *Konya, Turkey*

The basis of this method consists in localizing foreign bodies without any special apparatus or calculations. It is simple and practical.

After locating the foreign body by the usual

[1] Accepted for publication in April, 1939.

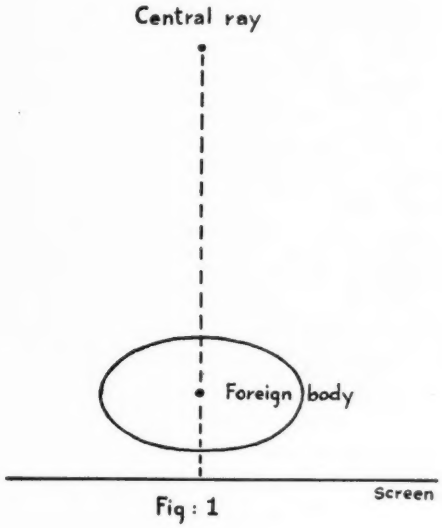

Fig : 1

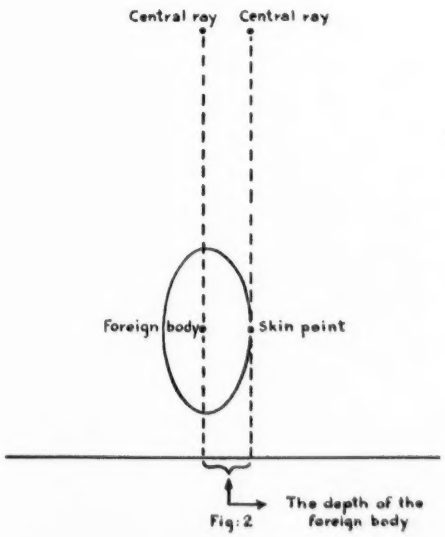

Fig: 2

method of radioscopic examination made with Holzknecht's cross, the center of the foreign body is marked on the patient's skin with a particle of lead, fixed by plaster. This particle of lead will act as a marker for the second position, as cited below (Fig. 1).

The patient is turned to left or right at an angle of 90° and one is able to visualize two shadows—one of the foreign body and one of the skin marker. One fixes these two points orthodiagraphically (Fig. 2). Thus we have two points fixed on the radioscopic screen. By measuring the distance between these two points, it is possible to ascertain the depth of the foreign body below the skin surface.

Conclusions.—A simple radioscopic method of determining the location and depth of foreign bodies is presented.

RADIOGRAPHY OF THE OPTIC FORAMINA EMPLOYING THE BULLITT MASTOID APPARATUS[1]

By BERNARD S. EPSTEIN, M.D., *and* MAX KULICK, *Brooklyn, New York*

From the Radiologic Service of M. G. Wasch, M.D., The Jewish Hospital of Brooklyn

The Bullitt apparatus for mastoid radiography, which provides a fixed angle of projection, can readily be utilized for obtaining radiograms of the optic foramina. This is made possible by placing the head so that the central ray traverses the contralateral asterion and emerges through the opposite optic foramen, projecting it as a circular shadow (Fig. 1).

With the patient supine and the occiput resting on the elevator of the Bullitt apparatus, the head is rotated until the external canthus of the eye is in contact with the cross mark on the celluloid window. The nose is then pressed firmly against the felt padding. If the nose does not reach the padding, it should be placed lightly against the celluloid window. The head should be neither flexed nor extended while being rotated into position (Figs. 2 and 3).

An 8 × 10 inch cassette, previously marked "right" and "left," is placed in its holder and the tube positioned as for mastoid radiography. Both exposures are made on the same film.

With children it is necessary to elevate the head so that the external canthus of the eye reaches the cross mark. It may also be occasionally necessary to vary the position of the external canthus of the eye in patients with long or short anteroposterior skull diameters. These patients' heads should be placed so that the external canthus is two or three millimeters above or below the cross mark.

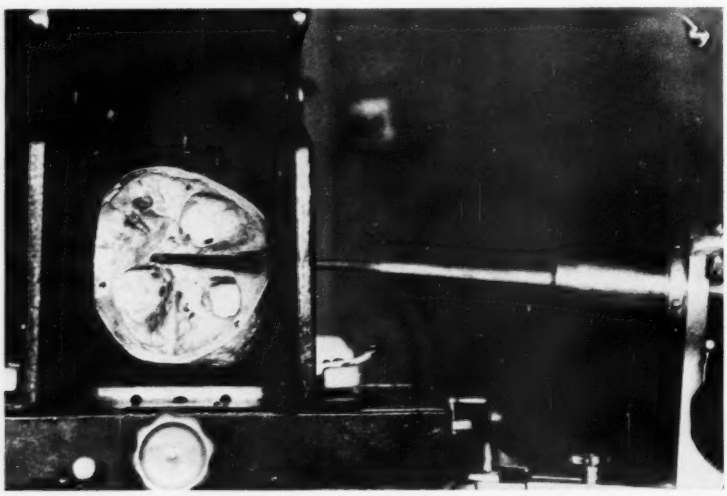

Fig. 1. Skull in position for radiographing left optic foramina. The path of the central ray is illustrated by the pointers.

COMMENT

A satisfactory film should show both orbital crests on the same level, indicating identical

[1] Accepted for publication in May, 1939.

Fig. 2.

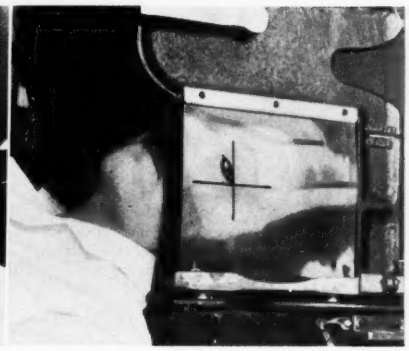

Fig. 3.

Fig. 2. Patient in position for radiographing left optic foramen.
Fig. 3. Lateral view of patient in position for radiographing left optic foramen.

projections. The optic foramina are seen as circular shadows within the orbits.

With practice it is possible to obtain comparable radiograms without undue difficulty.

AN UNUSUAL CASE OF MULTIPLE APPENDICEAL LITHIASIS[1]

By JOHN SHAHAN, M.D., *Clearwater, Florida*

This case is reported because of an unusually large number of calcified stones in the appendix diagnosed pre-operatively. The patient, white male, aged 37, weight 161, complained of a series of attacks of pain in the stomach, especially when empty, lasting about ten days, and coming on every few months for the past two years. During the intervals he felt perfectly well. Four times in the past eight months he had also had sudden attacks of agonizing pain over the course of the left ureter, lasting from 30 to 45 minutes and as suddenly abating.

Physical examination revealed no abnormalities nor areas of localized tenderness and the usual laboratory examinations were of little aid in diagnosis. There was a moderate leukocytosis, and a moderate diminution in gastric

[1] Accepted for publication in September, 1939.

Fig. 1. Flat film of the abdomen before administering barium or dye, showing stones in the appendix.

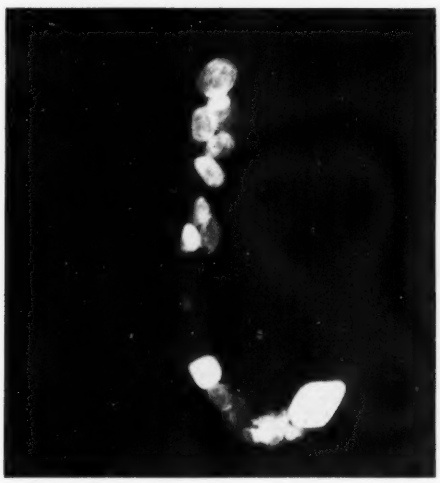

Fig. 2. X-ray appearance of the appendix after removal.

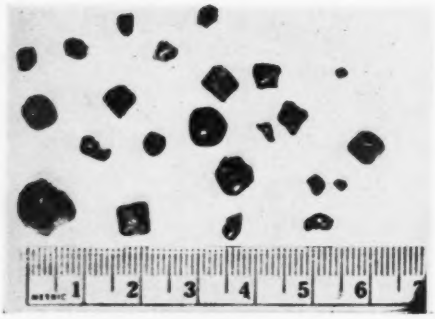

Fig. 3. Photograph of stones after removal, with metric scale showing relative size.

acidity. The stool showed no parasites nor other evidence of pathology.

In the course of the x-ray examination flat films were first made and will be referred to later. The stomach and duodenal bulb were next studied carefully and showed no evidence of gastric or duodenal ulcer or other lesions. There was, however, a definite hypermotility, the stomach emptying rapidly with no six-hour retention. This hypermotility was common to the entire gastro-intestinal tract, the barium having entered the sigmoid six hours after oral administration. The small and large intestine were otherwise normal.

After the oral administration of dye the gall bladder filled with normal appearance and the emptying time was normal.

Although the history for the past eight months suggested that, in addition to his digestive disturbance the patient had had four attacks of ureteral colic, no shadows of calculi were seen on the films, indicating that, if present, they were of the non-opaque variety, or had passed prior to the present examination, or that possibly the pain was of a referred nature.

Flat films of the abdomen before giving barium or dyes were very interesting. A long appendix was visualized extending from its cecal origin downward for about an inch and then curving sharply and extending upward and outward to within three-fourths of an inch of the level of the outer tip of the eleventh right rib. The major portion of the appendix was seen filled with opaque bodies, except about one and one-fourth inch of its distal end, which was filled with gas. Medial to the appendix at the levels of the lateral processes of the second and third lumbar vertebræ were also two calcified lymph nodes.

Because of the digestive disturbance the patient was referred to his surgeon for removal of the appendix. The lower half of a thickened appendix was firmly adherent to the colon and was dissected free with difficulty. The distal end was non-adherent. After removal, an x-ray film of the unopened appendix was made, after which it was opened and 23 hard calcified stones were removed, several octahedral in shape, others rounded or irregular in outline, and a number faceted. They ranged from light to dark brown in color and, when dry, were glistening and smooth and very hard and firm, and the original x-ray films show lamination in those not completely opaque.

The patient made an uneventful recovery and at present appears free of his former symptoms.

216 Coachman Building

RETROPERITONEAL LIPOSARCOMA WITH MYXOMATOUS DEGENERATION[1]

By JAMES M. FLYNN, M.D., *Rochester, New York*

The patient, M. M. K., a white female, widowed, aged 35, a school-teacher by occupation, was referred on July 12, 1939, for gastro-intestinal study. Her complaint was that since May she had noticed that her abdomen swelled after she had eaten, accompanied by what she called "stomach distress," regardless of the type of food that she had taken. The pain was not severe. She was constipated to some extent, with no evident diarrhea.

Fluoroscopic and radiographic examination on July 12 and 13, 1939, showed the stomach (Fig. 1), especially the pyloric end, and the duodenum displaced to the left of the midline, while the hepatic portion of the colon (Fig. 2) as well as the transverse were forced downward with no lesion within the lumen of the intestinal tract. The impression was that the displacement of the parts of the intestinal tract referred to was due to pressure from a large tumor of undetermined origin.

Pyelographic study of the kidneys (Fig. 3) showed no displacement of either kidney, with nothing unusual or abnormal in the kidney outline. On July 23, 1939, the patient entered a hospital for observation and further study.

Family History.—Father died of pneumonia at the age of 42; mother, aged 67, was alive and well. One brother, aged 42, and a sister, aged 33, alive and well. There was no history of tuberculosis, cancer, heart or kidney disease in the family.

Past History and Physical Examination.—Patient had the usual childhood diseases with uneventful recovery. Menstrual history: began at 14, regular, every 28 days, lasting three to four days. Had an occasional headache. Patient complained of abdominal distress after

[1] Accepted for publication in November, 1939.

eating. Had lost 12 1/2 pounds since May. Genito-urinary tract: some frequency. Occasional nocturia, no dysuria, no hematuria, no dysmenorrhea, no metrorrhagia, no menorrhagia. Pelvic examination showed small fibroid uterus with evidence of a cervical polyp.

Head: Eyes, pupils equal and regular, react to light and accommodation. Ears, clear. Nose, clear. Mouth, upper plate; tonsils atrophied. Pharynx, mucous membranes appear healthy. Neck, no palpable cervical glands and no hyperplasia. Chest: Heart, apex not displaced, heart tones strong and regular, no murmurs. Lungs, resonant, no râles; good vesicular breathing. Tactile and vocal fremitus, normal. Skin, clear. Extremities, no edema, no varicosities; reflexes normal. Abdomen, liver and spleen, not palpable. Question of a palpable mass in the epigastrium, to the right of the midline. Not positive of this mass, which, if present, was quite soft, somewhat suggestive of a cyst. No tenderness or rigidity. Blood pressure, 140/88. No elevation in temperature.

Laboratory Examination.—Urinalysis, sp. gr. 1.022; no albumen, no sugar. Nothing unusual in the catheterized specimen. Blood, Wassermann negative; cholesterin antigen, negative. Kahn precipitation test, negative. White blood cells, 5,650; red blood cells, 4,070,000.

Exploratory operation was advised and the patient consented.

Operation was performed on July 27, 1939: right parimedial incision, posterior peritoneum exposed laterally to the ascending colon which was displaced downward and toward the midline. The stomach and small bowel were all displaced to the left. A large retroperitoneal tumor involving the right kidney was dissected from the peritoneum and posterior abdominal wall. It was necessary to do a right nephrec-

Fig. 1.

Fig. 2.

Fig. 3.

tomy. The pedicle was ligated with No. 2 chromic. The ureter was dissected down to the fourth lumbar, ligated and cauterized. A tumor mass, the size of a football, with the kidney, was easily removed. A number of small vessels were ligated. T-rubber tissue counter drain was used. Posterior peritoneum was resutured with plain gut. The gall bladder and pancreas, as well as the liver, appeared perfectly normal. The abdomen was closed in layers by interrupted chromic silk, retaining and interrupted silk in the skin.

The patient was discharged from the hospital 16 days after the operation, with a practically uneventful recovery. To date, the woman had had no complaint.

The following is the pathologic report of the specimen:

Tumor and left kidney: The tumor was taken out in two parts; one, 15 × 15 × 5 cm. in size, consisted of lobulated fat tissue in which there were some nodules of translucent structure to be seen, of mucoid character. The other part, 20 × 15 × 7 cm. in size, contained a large mass surrounded by fat tissue. The mass was 10 cm. in diameter and showed homogenous soft structure of a white color. The capsule of this tumor was connected with the renal capsule but the kidney, which was also taken out, was not adherent to the capsule.

In this white tumor hemorrhages and small necroses were also found. A separate nodule, the size of a walnut, was present in the pararenal fat tissue. This nodule was of a white color, encapsulated, and on the cut surface showed fibrous network. In this tumor there was also felt a calcified mass. The kidney was 9.5 × 5 × 3 cm. in size and the capsule stripped off easily. The surface was smooth and the cut surface showed normal appearance.

Weights: Tumor taken out first, 970 grams; tumor taken out second, plus kidney, 1,250 grams; kidney weight, 120 grams; total weight of mass, 2,220 grams; without kidney, 2,100 grams.

Microscopic examination: Sections for microscopic examination were taken from 14 different parts of the tumor.

Sections taken from the lobulated lipomatous parts of the tumor showed lobules of large fat cells. The lobules, separated by large interlacing bundles of connective tissue, showed myxomatous degeneration. Embedded in this myxomatous tissue were branched fibroblastic cells, few in number.

Sections taken from areas where the myxomatous character was already more marked, showed smaller fat cells and wider bundles of myxomatous connective tissue.

Sections taken from the homogeneous white encapsulated mass around the kidney capsule showed fat cells small and comparatively few in number. Between the fat cells were large bundles of myxomatous connective tissue. These bundles showed numerous cells, most of them fibroblastic in character. The cells were irregular in shape and in their course. There were also numerous multinucleated cells and very large cells of the proportion of a giant cell. Beside these cells, there were observed large round cells with homogeneous protoplasm containing a few vacuoles. The nucleus of these cells were round with fine chromatin structure. These cells were probably fat cells. No mitotic figures could be found.

Sections taken from the fibromatous nodules showed interlacing bundles of fibroblast with a comparatively small amount of fibrils. Although most cells were of regular character, some larger cells were also seen. No mitotic figures.

Kidney: The cortical zone of the kidney seemed to be somewhat compressed. The arteries of medium size showed some proliferation of the intima; a few hyalin glomeruli were also seen.

The diagnosis was retroperitoneal liposarcoma with myxomatous degeneration and calcification. The tumor probably had only a low grade of malignancy.

The following is a description of the above pathology by Dr. James Ewing:

"The common liposarcoma of the trunk and extremities is derived from adult fat tissue and seems occasionally to be of traumatic origin. The primary tumor is of uncertain radiosensitivity, recurrent growths are radioresistant."

This case has been reported because of the rarity of the disease, as well as the extent of the involvement.

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PRESENT STATUS OF RADIOLOGICAL PRACTICE[1]

The program committee of this society has seen fit to place the subject of Medical Economics before you, along with the scientific discussions—an unprecedented procedure in this organization, I am sure, but one which will likely become a more common practice in medical groups in the years to come. There must be a reason for this. Are we not all beginning to feel at least a little pressure from the trend of events which threatens to change the order of our professional lives? Briefly, we might try to analyze the development of this relentless change in the social structure of this country, which, of course, is affecting individuals of all occupations and of none. For a century or more, with new frontiers to explore and with an apparently endless supply of resources, this nation progressed to an all-time high among civilizations in respect to national prosperity and a high average standard of living, under a system fostering capitalism and individual enterprise. Not that such a system was without its brutal abuses—many a group was left gasping by the wayside. At any rate, approximately contemporary with that other War, there began to creep in those tendencies of strong European flavor, with rapid acceleration of the pace in the past seven years. Whether of necessity a civilization, in aging a little, or upon finding its frontiers less expansive, inevitably drifts toward a more rigid socialistic control, or whether the abuses of our past hastened the issue, is beside the point. We still have private enterprise in these United States, but there is enough trouble brewing to run many a rugged individual ragged, and there will be no let-up after November of this year, regardless of whatever type of Deal comes after that.

It has not been my experience, until the past year or two, to have been more than dully aware that important changes were occurring which involved medical practice. Perhaps the proposed Wagner Act last year made us realize more than anything else what might happen, and that we shall be beset by other "Wagner" Acts is an accepted fact.

Without trying to imagine the confusion which may yet be in store for all physicians, let us confine this discussion mainly to a consideration of the present status of radiological medical practice. Included in the source of material for this exposition are bulletins and pamphlets received from Mac Cahal of the Inter-Society Committee, among which was the very thorough and exhaustive report of the Chairman of the Board of Chancellors of the American College of Radiology, presented at the February, 1940, meeting. In this 27-page report Dr. Chamberlain devotes much space to what he calls "An Economic Inventory of Radiology." Naturally, this is a competent treatise on the subject at hand and should certainly be made available to anyone interested.

It would be impractical for me to discuss fully all the problems that confront us, so I have chosen to lay emphasis on several topics which have seemed of particular importance, and will offer my viewpoint in a more or less informal way.

I.—THE SYSTEM OF REMUNERATION FOR RADIOLOGISTS

Aside from the radiologist with the private office, who collects his fees on the conventional fee-for-service basis, a large share of this work is done in hospitals, where the usual financial arrangements consist of a straight salary, a salary plus commission, percentage of gross or net income, or a rental basis. Now a point which has always interested me is the contention that "the best interests of the public will be served and the continued progress of the science of radiology will be assured if this speciality is practised on a fee-for-service basis, under which financial rewards to the practitioner are determined by ability, industry, and ambition." By implication this is critical of the straight salary system. But let us face the facts. There are many physicians,

[1] Presented at the annual meeting of the Pennsylvania Radiological Society, at Hershey, May 18, 1940, by J. H. Gemmell, M.D., Rochester, Pennsylvania.

radiologists among others, in Public Health Service, on the staffs of tuberculosis, mental, or city charity institutions, whose incomes are derived from public funds, almost necessarily a salary proposition; no question of an unsound policy arises there. The staff members of the Mayo Clinic and other similar groups are paid salaries, but it is my understanding that a form of partnership is established, giving the individual physicians certain control of their income. Many of our most able radiologists in large institutions, on a full-time basis, are perfectly satisfied with their salaries because they are adequate. Some radiologists may be dissatisfied with their salary arrangement, but feel helpless to effect a change. The Code of Ethics of the A. M. A. provides that: "It is unprofessional for a physician to dispose of his services to any lay body, organization, group of individuals—under terms or conditions which permit a direct profit from the fees, salary, or compensation received to accrue to the lay body or individual employing him—." It is obvious, of course, that under any established straight salary plan, a hospital might profit considerably from the x-ray department during busy times, and actually lose in a slow period, the latter being an extremely unusual occurrence, I am sure. Perhaps less frequently, but certainly a distinct possibility, a hospital may profit from x-ray services in cases in which the radiologist is paid an inadequate percentage of the gross or net income. Another item among these hospital-radiologist relationships is the usual but dubiously sound policy of having the hospital collect the fees. Perhaps the foregoing may seem to be inconsequential and unimportant, for who among you are now particularly interested in how you are paid, rather than in how much? Nevertheless, the future may make the "how" seem of greater importance, and if it becomes so, then the "how much" will be less than it was. One more remark or two along this line. We still see retention of the fee-for-service idea in many walks of life—the legal profession, many individual business enterprises, and even the most competent salesmen in large department stores are partially on a commission basis. And we cannot overlook the vast majority of medical practitioners, both general and those in most specialties, whose collective enterprise has helped to raise the general status of American medicine so high. It has occurred to me that it is the competitive influence of this large group which has so far served to keep bolstered up the economic standards of those not strictly in private practice. Do any of you believe that if all medical practice were to be suddenly institutionalized under lay management, on a similar basis to that of a radiologist on salary, the total net income of all physicians would be what it is now? It may be of some interest to recall that in the survey conducted by the Medical Economics Committee of this society last year, Pennsylvania radiologists on a salary at hospitals declared average incomes 45 per cent less than those of radiologists on a commission basis.

II.—DEFECTIONS IN OUR OWN RANKS

A. *Fee-splitting.*—I do not happen to know directly of any instance of this practice among radiologists in my community, but in a large eastern city ten years ago it was not unusual to hear of a physician getting a "kickback" from the radiologist for doing a gastro-intestinal series, or some other procedure. It was even common enough to hear of a physician referring a patient to an abortionist for a very substantial cut on the fee.

I believe the origin of this vicious practice lies within the profession itself, and its solution, if any, must emanate from the same source. The prize example of a situation which propagates this tendency is that of a general practitioner referring an appendectomy case to a surgeon. Under ordinary circumstances, the general physician may get a three-dollar fee for the house call, and the surgeon will collect a hundred dollars or more for the operation. The temptation to maneuver this discrepancy in fees surreptitiously is a great one, but why should not there be an open-and-above-board method of indicating to the patient the actual distribution of medical costs, either on the same or on separate billheads? There are enough hidden taxes as it is. In the above illustration, if the total medical fee is to be a hundred and three dollars, obviously the general practitioner is not getting a just return for his responsibility in the case, and it is up to the medical participants to develop an equitable adjustment. The public would soon learn to co-operate in such an arrangement, if the physicians would co-operate in establishing it.

Other types of fee-splitting amount to no less than petty racketeering. If a radiologist can afford to divert five dollars of a total twenty-dollar fee back to the referring physician, then he is charging too high a fee, and the

patient should get the benefit of the five-dollar reduction.

B. *Rigid and Excessively High Fee Schedules.*—I believe that radiologists are less frequently offenders in this respect than physicians in other specialties. It may be difficult to define what an excessively high fee is, but I am convinced that such practices by the few have been one of the important stimuli to the recent agitation for medical regimentation with which we are threatened. One personal experience along that line was the consultation of a "cancer specialist," not a radiologist, on a case of advanced carcinoma of the lung. The consultation fee was $150 for about one and one-half hours' conference with attending physicians and family, and at most a total loss of time of four hours. Ethically, there was nothing else to complain about, there being complete accord between consultant and attendants as to treatment, prognosis, and even the diagnosis. The family of the patient was in very modest circumstances. Incidentally, the other medical fees in the case, including the radiological and that of the internist for the next several weeks until death, totalled about $95.

But the day of the physician who is in the habit of charging all the traffic will bear is inevitably drawing to a close. And rightly so, for then the majority will no longer receive the general criticism of exhorbitance, for which the few are responsible.

C. *Failure of Radiologists to Personalize Their Practice with Clinical Observation and Personal Contact with the Patient.*—The nature of diagnostic radiology is such that circumstances are frequently present to bring this about. No doubt we might do better if we could personalize our entire practice, instead of so often depending on a brief word from the referring physician. Unquestionably our lack in this regard has fostered such unpleasantries as the division of diagnostic radiology into technical and professional phases.

III.—COMPETITION PROBLEMS

A. *The General Practitioner with an X-ray Unit but no Special Qualifications in X-ray.*—In a certain few communities where there is no qualified radiological service within reasonable range, there is probably a real need for this. However, the general man will get very little referred x-ray work from his competitors in general practice, if there is available an experienced radiologist, capable of doing superior work.

B. *The Lay Radiographer.*—In a few localities this has been a troublesome problem, but here again, if a radiologist is worth his salt, the increased value of his services will eventually merit the entire support of the medical profession. I understand this is not a very serious difficulty throughout the country as a whole.

C. *Other Medical Specialists with X-ray Units.*—In most instances of this sort, I am sure, competition is entirely fair. What fault should we find with an orthopedic surgeon or urologist who wishes to have x-ray service in his own office, necessarily assuming that he has become qualified in interpreting his results?

D. *Cut-rate Competition among Radiologists.*—This procedure has more serious ultimate implications than any of the foregoing, and it is up to the individual offenders to desist.

E. *Commercialized Mass Chest Surveys.*—In certain communities, the Powers Film Company has brought in a portable x-ray machine to schools or factories and made examination, for a dollar fee, of large groups of individuals, on rolls of paper film. This is done under the auspices of local tuberculosis associations, of industrial organizations, etc. In my county, the tuberculosis association has sponsored this for the past six or seven years. My predecessor did not wish to have anything to do with it and, for a while, the films were sent to Harrisburg to one of the personnel in the State Tuberculosis Association, for interpretation. For the past several years I have taken over the interpretation for a very small fee per film, more to keep that part of it a local matter than for any other reason. Aside from any discussion of the merits of this type of examination, which, in my opinion, is well worth the dollar, I think the unfortunate thing about these surveys is that in most instances it is not the radiologist who is sponsoring them. If there is an established need for mass chest roentgenography at low cost, perhaps we ought to be operating these plans ourselves, because we eventually have to read the films anyway. All the Pittsburgh men are familiar with the situation that originated there last Fall. A demand for chest examination of certain school groups arose, and the local radiologists blocked the influx of the Powers Company by taking over the work

themselves, assigning different groups to the various men at their offices or hospitals. Using celluloid film and lacking "mass production" facilities, this is not a practical procedure, and I wonder if there is not some other answer to it. The apparent demand for this sort of thing in the Pittsburgh district alone would probably warrant the purchase of a portable x-ray unit, truck, rolls of paper or celluloid film, by a group of radiologists who could then arrange for the technical help and be in entire control of the whole business. It is also possible that the method of roentgen-photography may prove to be a very satisfactory means of conducting low cost mass surveys, because of the very low material cost.

F. *Governmental and Other Clinics.*—We are all familiar with the activities of clinics of various types in our own communities, and it is easy to foresee what might happen to private medical practice if present tendencies toward governmental invasion of additional fields of endeavor develop. The 1939 Inter-Society Committee report warns of the possibility, for example, of establishment of cancer clinics for diagnosis and treatment. The National Cancer Institute, a division of the Public Health Service, is entirely a research organization now, but there is a proviso in the new Wagner Health Bill for 500 diagnostic centers, at a cost of $30,000 each, and in the National Health Program are recommendations for an annual expenditure of $25,000,000 for "cancer control."

G. There are other existing types of competition affecting radiologic practice, such as industrial clinics and certain insurance schemes which we will not go into here.

IV.—GROUP HOSPITALIZATION

In a general way, I do not believe anyone can deny the merit of this rapidly growing movement, if one is to approve of the insurance idea at all. It is unquestionably a sound policy to carry life insurance or to have fire insurance on your home, so why would it not be equally advantageous for an individual to prepay a portion of his health risk, to safeguard against a possible calamitous hospital bill? Unfortunately, most of these hospitalization plans have incorporated certain features considered objectionable by the medical profession. In the main, it is the inclusion of medical services which precipitates most of the controversy—radiology, anesthesia, and pathology being generally involved. Apart from the ethical consideration of the sale of medical services, let us analyze the probable viewpoint of the radiologist from the financial angle. If he be on a straight salary or on a full time percentage basis, he is not affected; if he has a private office he may be affected, if subscribers are referred to a hospital solely for diagnostic purposes. In certain hospital service plans, this is part of the contract, in others "free x-rays" are advertised, and in still others x-rays "incident to hospitalization" may be subject to a various interpretation. Thus far, I suppose the average radiologist has gained as much financially as he has lost through group hospitalization, so that ostensibly the ethical principles must be the important factor in efforts to delete medical services from these plans. And radiologists and pathologists are not alone in these efforts; organized medicine as exemplified in the A. M. A. has unreservedly taken the same stand. The reason is obvious. Other medical groups are beginning to realize that medical services other than those mentioned may yet be included in group hospitalization plans, as indeed they already are in certain localities. Dr. Chamberlain devoted about seven pages of his February report to a discussion of the ambitions of hospital plan executives in respect to enlarging the scope of medical services to be sponsored by hospitals. One of these authorities proposed at the last annual meeting of the American Hospital Association in Toronto that hospitals establish faculties of doctors with definite salaries as a means to combat socialized medicine.

As for the Hospital Service Plans in force in Pennsylvania, radiology, pathology, and anesthesia were included in the contracts, presumably with the tacit approval of certain medical officials of the State Medical Society. And the seeds of ambition have apparently sprouted in the organization back of these plans. About three weeks ago, the Pennsylvania Hospital Association sent a form letter around to the board members of all participating hospitals, suggesting that there had been a "demand" for other medical services to be included in the contracts.

V.—PROGRESSIVE CHANGES SPONSORED BY THE MEDICAL PROFESSION

According to present indications, all physicians may experience sometime in the future drastic changes in their economy. We are pitted against the forces of public opinion,

developed principally by certain socialistic minded and political groups, who contend that we are horse-and-buggy doctors obstructing progress. On the other hand, with the exception of a minor but influential few, the majority of us feel that the existing system has fostered a progress which indicates that American medicine is second to none in the world, and that the good in it should be retained. Just because our system is imperfect in certain details, why should it be necessary to have a wholesale substitution of it by a system hampered with lay and political control?

Now what is organized medicine doing to forestall the approach of undesirable policies or to alter the objectionable features of existing developments? It goes without saying that our present dilemma would be less acute if the medical profession had displayed awareness of these many problems at their inception years ago. I believe, for example, that hospital-physician relationships would be essentially tranquil to-day had all physicians maintained an active participation in hospital management from every standpoint, and unquestionably the patients would have benefited too. Also, the profession might have done well to have maintained an alert, politically minded representation, who could have insisted on having a voice in any projected civic or governmental enterprise involving medical practice.

There are already signs of much activity cropping out among medical groups in various parts of the country. One movement of apparent particular importance is that of Voluntary Medical Service Insurance. These are nonprofit plans controlled by physicians, inaugurated to avoid possible similar systems sponsored and operated by political groups. Now there is no certainty that these plans will be generally successful, because the policies will be expensive enough to repel certain individuals in the income levels they are designed to serve. Very possibly many of these will prefer to take their chances on good health than make a regular prepayment, frequently without return in services, and, of course, some of these individuals customarily default on their medical bills anyway, under the present system. Nevertheless, I believe that vigorous efforts should be made to promote the success of such insurance ideas, because if they then fail, at least our sincere attempts will have demonstrated to political schemers that the population does not "voluntarily" want these things.

In California a medical service plan is in operation now, backed up almost 100 per cent by the physicians; it is my understanding that physicians also have control of the hospitalization insurance, and that the two types of policies are frequently sold to groups together. In Michigan the group hospitalization organization is separate from the medical service organization but the two work closely together, and indeed have offices in the same building. The former of the two has been in operation for some time and its officials originally intended including radiology, anesthesia, and pathology in their plan, but the medical profession was insistent on deletion of these medical services, and was successful. Their medical service insurance is just beginning to function now on a limited scale, and the three specialties just mentioned are to be given consideration equal to that of all other services, whether a patient is in or outside the hospital. You are all undoubtedly familiar with developments along this line in Pennsylvania. The Voluntary Insured Medical Service was finally approved by action of the State Society House of Delegates, Feb. 28, 1940, and operative details are now being worked out before offering the policies to the public. As you know, 15 representatives of the three radiological societies of this State met in Philadelphia on Dec. 2, 1939, from which emanated a 13-page report carrying recommendations in regard to the new plan. Copies of this report were sent to the proper committees of the State Medical Society, and I believe it contributed a definite effect on the final result of their deliberations. Unfortunately, we were not at this time able to obtain coverage for radiology in cases in which persons have that coverage under their group hospitalization policies, although efforts were made in that direction.

In addition to the above mentioned programs, organized medicine is showing much more activity in the various phases pertinent to medical economics. You have now only to read almost any of our scientific publications and see considerable space devoted to the subject. Strong efforts are being made to build up influence with political forces so that our viewpoints may get fair consideration. All of us have received many letters, pamphlets, and requests for support from the National Physicians Committee, which began active operation about eight months ago. Apparently this is a step in the right direction and warrants at least a careful appraisal.

As radiologists, I think we may be justly proud of our local, sectional, and national organizations. Each of these offers splendid facilities for continued progress in our qualifications. The combined efforts of the several national organizations resulted, seven years ago, in the American Board of Radiology, an important step forward. Since 1935, the American College of Radiology has made significant advances, and the recent opportunity offered us to affiliate with that body should serve to unite our entire forces into an intelligent unit, capable of great good.

A word should be said about us as individuals. It is up to us to do the best we can professionally in our own communities, both in our work and in our contacts with medical confrères and institutional associates. For we have continually to show proof of our worth, and by so doing, we are enabled to solve many of our local difficulties satisfactorily. We should and must support our regional and national organizations, for their aims are high in setting up educational standards and in attaining to establishment of a more ideal economy. But we should not expect nor would we want that these organizations should become so powerful that hospitals, for example, would be forced to keep us around just because of our membership in Medical Union No. X.

In conclusion, let us have trust that our economic difficulties may never be more serious than suggested in this report. In the light of these amazing world events, this is perhaps too much to expect, but we all can at least try to preserve the better things in our American Way of Life.

RADIOLOGICAL SOCIETIES IN NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate with the Editor by supplying him with information for this section? Please send such information to Leon J. Menville, M.D., 1201 Maison Blanche Bldg., New Orleans, La.

UNITED STATES

CALIFORNIA

California Medical Association, Section on Radiology.—Chairman, Karl M. Bonoff, M.D., 1930 Wilshire Blvd., Los Angeles; *Secretary,* Carl D. Benninghoven, M.D., 95 S. El Camino Real, San Mateo.

Los Angeles County Medical Association, Radiological Section.—President, M. L. Pindell, M.D.; *Vice-president,* Richard T. Taylor, M.D.; *Secretary,* Wilbur Bailey, M.D., 2007 Wilshire Blvd.; *Treasurer,* Henry Snure, M.D., 1414 South Hope Street; Kenneth Davis, M.D., *Member of Executive Committee.* Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Club.—Chairman, Karl M. Bonoff, M.D., Los Angeles; *Members of Executive Committee,* I. S. Ingber, M.D., A. C. Siefert, M.D., D. R. MacColl, M.D.; *Secretary-Treasurer,* L. Henry Garland, M.D., 450 Sutter St., San Francisco. Executive Committee meets quarterly; Club meets annually during annual session of the California Medical Association.

San Francisco Radiological Society.—Secretary, Harold A. Hill, M.D., 450 Sutter Street. Meets monthly on third Thursday at 7:45 P.M., for the first six months at Toland Hall (Univ. of Calif. Med. School) and for the second six months at Lane Hall (Stanford Univ. School of Med.).

COLORADO

Denver Radiological Club.—President, N. B. Newcomer, M.D., 306 Republic Bldg.; *Vice-president,* Elizabeth Newcomer, M.D.; *Secretary,* Paul R. Weeks, M.D., 520 Republic Bldg.; *Treasurer,* L. G. Crosby, M.D., 366 Metropolitan Bldg. Meets third Friday of each month at homes of members.

The Sixth Midsummer Radiological Conference in the Rocky Rountains will be held in Denver, Aug. 8, 9, and 10, 1940. *Guest speakers:* Lewis G. Allen, M.D., Kansas City, Kans.; Fred E. Angle, M.D., Kansas City, Mo.; Howard P. Doub, M.D., Detroit, Mich.; Edwin C. Ernst, M.D., St. Louis, Mo.; Howard B. Hunt, M.D., Omaha, Nebr., Charles L. Martin, M.D., Dallas, Texas, and Albert Soiland, M.D., Los Angeles, Calif. A complete program will be sent on request. No registration fee.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Chairman, Owen J. Groark, M.D., 881 Lafayette St., Bridgeport; *Secretary-Treasurer,* Max Climan, M.D., 242 Trumbull St., Hartford. Meetings twice annually in May and September.

The annual meeting of the Section on Radiology of the Connecticut State Medical Society was held on May 23, 1940, at Hartford. Richard Schatzki, M.D., of Boston, was the speaker, his subject being "Roentgenological Examination in Hemorrhage of the Upper Gastro-intestinal Tract." T. Grier Miller, M.D., of Philadelphia, was the guest discussant.

DELAWARE

Affiliated with Philadelphia Roentgen Ray Society.

FLORIDA

Florida Radiological Society.—President, H. B. McEuen, M.D., Jacksonville; *Vice-president,* Joseph H. Lucinian, M.D., Miami; *Secretary-Treasurer,* John N. Moore, M.D., 210 Professional Bldg., Ocala. Meetings held in November and at the annual meeting of the Medical Association of Florida in the spring.

GEORGIA

Georgia Radiological Society.—President, Robert Drane, M.D., DeRenne Apts., Savannah; *Vice-president,* J. J. Collins, M.D., Archbold Hospital, Thomasville; *Secretary-Treasurer,* Robert C. Pendergrass, M.D., Prather Clinic Bldg., Americus. Meetings twice annually, in November and at the annual meeting of the Medical Association of Georgia in the spring.

ILLINOIS

Chicago Roentgen Society.—President, Adolph Hartung, M.D.; *Vice-president,* Warren W. Furey, M.D.; *Secretary,* Chester J. Challenger, M.D., 3117 Logan Blvd. The Society meets at the Palmer House on the second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—President, Harry W. Ackeman, M.D., 321 W. State St., Rockford; *Vice-president,* D. R. Hanley, M.D., St. Mary's Hospital, Streator; *Secretary-Treasurer,* William DeHollander, M.D., St. John's Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Chairman, Warren W. Furey, M.D., 6844 Oglesby Ave., Chicago; *Secretary,* Harry W. Ackeman, M. D., 321 W. State St., Rockford.

INDIANA

The Indiana Roentgen Society.—President, H. H. Inlow, M.D., Shelbyville; *President-elect,* Charles Wyeth, M.D., Terre Haute; *Vice-president,* C. A. Stayton, M.D., Indianapolis; *Secretary-Treasurer,* Clifford C. Taylor, M.D., 23 E. Ohio St., Indianapolis. Annual meeting in May.

The 1940 annual meeting was held in Indianapolis on May 19. E. A. Pohle, M.D., was a guest of the day and, after dinner, read a paper on "Radium Treatment of Vascular Nevi."

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—President, D. B. Harding, M.D., Lexington; *Vice-president,* I. T. Fugate, M.D., Louisville; *Secretary-Treasurer,* Joseph C. Bell, M.D., 402 Heyburn Bldg., Louisville. Meeting annually in Louisville, third Sunday afternoon in April.

MAINE

See New England Roentgen Ray Society.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Chairman, Harold E. Wright, M.D., 101 W. Read St.; *Secretary,* Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

MASSACHUSETTS

See New England Roentgen Ray Society.

MICHIGAN

Detroit X-ray and Radium Society.—President, O. J. Shore, M.D., 552 Fisher Bldg., Detroit; *Vice-president,* Clarence E. Hufford, M.D., 421 Michigan St., Toledo, Ohio; *Secretary-Treasurer,* E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—President, J. H. Dempster, M.D., Detroit; *Vice-president,* L. E. Holly, M.D., Muskegon; *Secretary-Treasurer,* J. E. Lofstrom, M.D., 1536 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—President, Harry Weber, M.D., Mayo Clinic, Rochester; *Vice-president,* G. T. Nordin, M.D., Minneapolis; *Secretary,* John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

The twelfth annual meeting was held in Rochester on April 23, 1940. Dr. Bernard Nichols, of Cleveland, President of the Radiological Society of North America, delivered the Annual Carman Lecture before the Minnesota State Medical Society, the title of the lecture being "Indications for the Use of Excretory Urography in Diagnosis." At the dinner and business meeting in the evening, Dr. Nichols addressed the society on, "The Future of Radiology."

MISSOURI

The Kansas City Radiological Society.—President, L. G. Allen, M.D., 907 N. 7th St., Kansas City, Kansas; *Secretary,* Ira H. Lockwood, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—President, Oscar C. Zink, M.D., St. Luke's Hospital; *Secretary,* Wilbur K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of October, January, March, and May, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—President, Roy W. Fouts, M.D., 1007 Medical Arts Bldg., Omaha; *Secretary,* D. Arnold Dowell, M.D., 816 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY

(Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.) *President,* Langdon T. Thaxter, M.D., Maine General Hospital, Portland, Maine; *Secretary,* Aubrey O. Hampton, M.D., Massachusetts General Hospital, Boston. Meetings third Friday of each month from October to May, inclusive, usually at Boston Medical Library.

NEW HAMPSHIRE

See New England Roentgen Ray Society.

NEW JERSEY

Radiological Society of New Jersey.—President, P. S. Avery, M.D., Middlesex Hospital, New Brunswick; *Vice-president,* J. G. Boyes, M.D., 912 Prospect Ave., Plainfield; *Treasurer,* H. A. Vogel, M.D., 1060 E. Jersey St., Elizabeth; *Secretary,* W. James Marquis, M.D., 198 Clinton Ave., Newark; *Counsellor,* A. W. Pigott, M.D., Skillman. Meetings at Atlantic City at time of State Medical Society, and Midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—President, I. J. Landsman, M.D., 910 Grand Concourse, New York City; *President-elect,* D. E. Ehrlich, M.D., 35 West 92nd St., New York City; *Vice-president,* Frederic E. Elliott, M.D., 122 76th St., Brooklyn; *Treasurer,* Solomon Fineman, M.D., 133 East 58th St., New York City; *Secretary,* William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—President, A. L. L. Bell, M.D., Long Island College Hospital, Henry, Pacific, and Amity Sts.; *Secretary-Treasurer,* L. J. Taormina, M.D., 1093 Gates Ave. Meetings first Tuesday in each month at place designated by president.

Buffalo Radiological Society.—President, Edward Koenig, M.D., 100 High St., Buffalo; *Vice-president,* W. Roger Scott, M.D., 598 Pine St., Niagara Falls; *Secretary-Treasurer,* Joseph S. Gian-Franceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—President, Jesse Randolph Pawling, M.D., 305 Clinton St., Watertown, *Vice-president,* Albert Lenz, M.D., 613 State St., Schenectady; *Secretary-Treasurer,* Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—President, Samuel G. Schenck, M.D., Brooklyn; *Vice-president,* G. Henry Koiransky, M.D., Long Island City; *Secretary,* Marcus Wiener, M.D., 1430 48th St., Brooklyn; *Treasurer,* Louis Goldfarb, M.D., 608 Ocean Ave., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—President, Harry M. Imboden, M.D., 30 W. 59th St., New York City; *Vice-president,* Henry K. Taylor, M.D., 667 Madison Ave., New York City; *Secretary,* Roy D. Duckworth, M.D., 170 Maple Ave., White Plains, N. Y.; *Treasurer,* Eric J. Ryan, M.D., St. Luke's Hospital, New York City.

Rochester Roentgen-ray Society.—Chairman, George H. S. Ramsey, M.D., 277 Alexander St.; *Secretary,* S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—President, Robert P. Noble, M.D., 127 W. Hargett St., Raleigh; *Vice-president,* A. L. Daughtridge, M.D., 144 Coast Line St., Rocky Mount; *Secretary-Treasurer,* Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meetings with State meeting in May, and meeting in October.

OHIO

Ohio Radiological Society.—At the annual Ohio State Medical Meeting the radiologists of Ohio met at a business-dinner meeting, the purpose of which was to organize a State Radiological Society. The meeting was well attended. A president and secretary were elected. *President,* U. V. Portmann, M.D., Cleveland; *Secretary,* J. E. McCarthy, M.D., Cincinnati. A committee was appointed to draw up a constitution and by-laws. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—President, L. A. Pomeroy, M.D., Hanna Bldg., Cleveland; *Vice-president,* P. C. Langan, M.D., 215 Wellsley Ave., Akron; *Secretary-Treasurer,* H. A. Mahrer, M.D., 10515 Carnegie Ave., Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*President,* Samuel Brown, M.D.; *Secretary-Treasurer,* Justin E. McCarthy, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—President, Louis A. Milkman, M.D., Medical Arts Bldg., Scranton; *First Vice-president,* James E. Ginter, M.D., Dubois; *Second Vice-president,* Alexander Stewart, M.D., Shippensburg; *Secretary-Treasurer,* L. E. Wurster, M.D., 416 Pine St., Williamsport; *President-elect,* Harvey N. Mawhinney, M.D., 6546 Darlington Road, Pittsburgh; *Editor,* William E. Reiley, M.D., Clearfield; *Assistant Editor,* Sydney J. Hawley, M.D., Danville.

The Philadelphia Roentgen Ray Society.—President, Jacob H. Vastine, II, M.D., Medical Arts Bldg., Philadelphia; *Vice-president,* A. Maxwell Sharpe, M.D., 708 Sproul St., Chester; *Secretary,* Barton R. Young, M.D., Temple University Hospital, Philadelphia; *Treasurer,* Fay K. Alexander, M.D., Chestnut Hill Hospital, Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—President, Zoe A. Johnston, M.D., 601 Jenkins Arcade; *Vice-president,* Prentiss A. Brown, M.D., and *Secretary-Treasurer,* Harold W. Jacox, M.D., 4800 Friendship Ave. Meetings held second Wednesday of each month at 4:30 P.M., from October to June at various hospitals designated by program committee.

RHODE ISLAND

See New England Roentgen Ray Society.

SOUTH CAROLINA

South Carolina X-ray Society.—President, T. A. Pitts, M.D., Columbia; *Secretary-Treasurer,* Malcolm Mosteller, M.D., Columbia Hospital, Columbia. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

SOUTH DAKOTA

Meets with Minnesota Radiological Society.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—President, Eugene Abercrombie, M.D., 305 Medical Arts Bldg., Knoxville; *Vice-president,* Christopher C. McClure, M.D., 404 Doctors Bldg., Nashville; *Secretary-Treasurer,* Franklin B. Bogart, M.D., 311 Medical Bldg., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—President, C. F. Crain, M.D., Corpus Christi; *President-elect,* M. H. Glover, M.D., Wichita Falls; *First Vice-president,* G. D. Carlson, M.D., Dallas; *Second Vice-president,* P. E. Wigby, M.D., Dallas; *Secretary-Treasurer,* L. W. Baird, M.D., Scott and White Hospital, Temple. Meets annually. The next annual meeting is to be Jan. 18, 1941, in Sherman.

VERMONT

See New England Roentgen Ray Society.

VIRGINIA

Radiological Society of Virginia.—President, Fred M. Hodges, M.D., 100 W. Franklin St., Richmond; *Vice-president,* L. F. Magruder, M.D., Raleigh and College Aves., Norfolk; *Secretary,* V. W. Archer, M.D., University of Virginia Hospital, Charlottesville.

WASHINGTON

Washington State Radiological Society.—President, H. E. Nichols, M.D., Stimson Bldg., Seattle; *Vice-president,* George Cornett, M.D., Yakima; *Secretary-Treasurer,* Kenneth J. Holtz, M.D., American Bank Bldg., Seattle. Meetings fourth Monday of each month at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—President, H. W. Hefke, M.D.; *Vice-president,* Frederick C. Christensen, M.D.; *Secretary-Treasurer,* Irving I. Cowan, M.D., Mount Sinai Hospital, Milwaukee. Meets monthly on first Friday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russel F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Section on Radiology, Canadian Medical Association.—Chairman, Gordon Richards, M.D., Medical Arts Bldg., Toronto; *Secretary,* W. J. Cryderman, M.D., Medical Arts Bldg., Toronto.

Section on Radiology, Ontario Medical Association.—Chairman, E. H. Shannon, M.D., St. Michael's Hospital, Toronto; *Secretary,* W. J. Cryderman, M.D., 474 Glenlake Avenue, Toronto.

Canadian Association of Radiologists.—President, J. E. Gendreau, M.D., Montreal; *Vice-president,* W. H. McGuffin, M.D., Calgary; *Honorary Secretary-Treasurer,* W. L. Ritchie, M.D., Montreal; *Chairman of Interrelations Committee,* G. E. Richards, M.D., Toronto.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

THE PHYSICIAN AS A LEADER

Psychologists divide mortals into two general classifications; one is called the subjective type, the other the objective. The subjective type of personality glories in working on his own responsibility and does his best work by himself with subordinate help, if any. He wishes to know more and more about some particular phase of human activity and to become the expert in medicine, in engineering, or in the arts—he engages in research work—he dreams—he creates—he invents—by and large, he does the world's work. The objective type is exo-centric. He is the power and personality boy. He knows a little about a great many things and not too much about any one thing. He becomes the executive, the politician, or the statesman. He sells the work of the hands of the subjective type. In the main, the world is run by the objective type.

Some of us, of course, are altogether subjective or objective, while the majority of us have some of both characteristics but lean more strongly one way or the other. It now becomes apparent why physicians are not particularly successful in presenting their work, their cause, and their point of view; why they are not good politicians and why so frequently they squirm and wiggle because some layman is the executive who tries to direct and control their work and tell them how and where the work of their hands and brains should be carried out.

The old-time family physician, the doctor, was a generation ago the father confessor and adviser to persons, not only in matters of health but in economics and human relations of all kinds. He helped John secure finances for the purchase of a barn or more cattle; he gave Mary useful advice in matters of the heart. He must have been objective- as well as subjective-minded since, in many, many ways, he was a power and influence in the community. As medicine has become more and more intricate, as the field of technical knowledge has expanded, too many of us have ceased to be "a doctor"—one who is learned—and have lost our interest for knowledge in fields other than those that concern our daily work; and so we have become highly trained technicians. Is it any wonder that we have gradually, as subjective-minded persons, come under the control of the objective-minded members of the community? It is high time that we make a conscious effort to become partially objective-minded; that we seek positions in our community on Boards of Health or Education; that we run for the City Council, and that we once again exert our personality and intelligence and win back the esteem and the respect of the community because of our efforts for community welfare in general. We should once again produce our rightful proportion of leadership in all phases of human activity. The names of three physicians who were leaders in the political life of our country come quickly to mind—Benjamin Rush, one of the signers of the Declaration of Independence; William Newhall, Governor of the State of New Jersey, Member of Congress, Governor of the Territory of Washington, and Organizer of the Life Saving Service along our coasts, and General Leonard Wood, with whose career we are all familiar. If we serve our fellow-men not only as skilled physicians but as intelligent leaders, we will be in a position to have our opinion in technical matters fully accepted because of our ability to lead in other lines. If we fail to assume such leadership, we will increasingly be forced to assume the rôle of the subjective technician objectively directed—such is the way of life.

WILLIAM GETTIER HERRMAN, M.D.

Asbury Park, N. J.

ANNOUNCEMENTS

AMERICAN CONGRESS OF PHYSICAL THERAPY

The nineteenth annual scientific and clinical session of the American Congress of Physical Therapy will be held Sept. 2, 3, 4, 5, and 6, 1940, at the Hotel Statler, Cleveland, Ohio.

The mornings will be devoted to the annual instruction course, enabling attendance at both the course and scientific sessions which will be given in the afternoons and evenings. This will minimize the time element and permit attendance at both functions during the same week. The seminar and convention proper will be open to physicians and qualified technicians.

Numerous new features will be manifest in the 1940 program. While every phase of physical therapy will be covered in the general program, special emphasis will be laid on the use of physical measures in general practice. Symposia dealing with light, heat, and electricity as important therapeutic adjuvants in general medical and surgical practice will appeal to every physician interested in modern therapy.

For information concerning the seminar and preliminary program of the convention proper address American Congress of Physical Therapy, 30 North Michigan Avenue, Chicago.

CONFERENCE ON APPLIED NUCLEAR PHYSICS

A general Conference on Applied Nuclear Physics, sponsored by the American Institute of Physics in co-operation with the Massachusetts Institute of Technology, will be held during the week of Oct. 28 to Nov. 2, 1940, at the Massachusetts Institute of Technology, Cambridge, Mass. The rapidly increasing number of applications of methods and apparatus characteristic of nuclear physics in the fields of biology, radiology, chemistry, geology, and industrial physics has long emphasized the usefulness of a joint conference between physicists and their colleagues in other fields of science.

The purposes of the Conference are to bring together investigators who may be widely separated geographically, and to provide a forum for assembling and correlating present knowledge and difficulties, and for directing attention toward fundamental lines of research which should be the subject of future investigations.

The week's activities will be divided into separate sessions on applications to biology, chemistry, radiology, metallurgy, geology, and to general sessions relating to the production and use of radio-active and stable isotopes, and the protection of workers from radiation.

Committee in charge of program: Robley D. Evans, *Chairman*, Massachusetts Institute of Technology; Elmer Hutchisson, *Secretary*, University of Pittsburgh; Henry A. Barton, American Institute of Physics; Edward U. Condon, Westinghouse Electric and Manufacturing Co.; Lee A. DuBridge, University of Rochester; G. Failla, Memorial Hospital, New York City; Clark Goodman, Massachusetts Institute of Technology; Ernest O. Lawrence, University of California, and Harold C. Urey, Columbia University.

THE AMERICAN COLLEGE OF PHYSICIANS

The Twenty-fifth Annual Session of the American College of Physicians will be held in Boston, with general headquarters at the Statler Hotel, April 21–25, 1941.

James D. Bruce, M.D., of Ann Arbor, Mich., is President of the College and will have charge of the program of general scientific sessions. William B. Breed, M.D., of Boston, has been appointed General Chairman of the Session and will be in charge of the program of clinics and demonstrations in the hospitals and medical schools and of the program of panel and round-table discussions to be conducted at the headquarters.

COMMUNICATIONS

EDITH QUIMBY HONORED

Mrs. Edith H. Quimby is so well known to American and European radiologists that it is entirely superfluous to recount her attainments in radiological physics, for which the honorary degree of Doctor of Sciences was conferred on her, June 3, 1940, by her Alma Mater, Whitman College, Walla Walla, Washington.

Another deserved honor came to Mrs. Quimby when on June 10 she delivered the Janeway Lecture before the American Radium Society and received the Janeway Medal at the banquet the same evening.

This year marks the twentieth anniversary of the time when Mrs. Quimby first became associated with the writer in the Physics Department of the Memorial Hospital. It is hardly necessary to mention that this association has always been most co-operative and pleasant, for Mrs. Quimby's remarkable personality is known to all who have come in contact with her, and is attested by the fact that she is affectionately referred to by most radiologists as "Edith Quimby."

The staff of Memorial Hospital is proud of Mrs. Quimby, her achievements, and the honors which have been conferred on her.

G. FAILLA.

REPORT OF STANDARDIZATION COMMITTEE

1. *The Specification of Quality.*—It was suggested that, for clinical purposes, quality may be expressed somewhat loosely since small quality differences are not important. In cases in which purely technical considerations are involved the quality should be measured carefully and in accordance with our earlier recommendations.

It is strongly suggested that the materials used in quality measurements be limited to the following: cellophane, aluminum, copper, tin, and lead (in accordance with the recommendations of the I.C.R.U.). At the same time, the filter materials used in clinical practice should be limited to the above materials. Filters of zinc, silver, iron, etc., should not be used. Particular thicknesses of filter for clinical use should not be specified by the Committee. Provision must be made for filtering out radiation that may be transmitted through the heavier filters in the region of their characteristic absorption limits.

The limits defining the regions in which different filter materials are used for both treatment purposes and quality measurements were set forth by the I.C.R.U., but the Committee is of the opinion that the method of specifying the limits is open to objection. The I.C.R.U. proposals give these limits in terms of the tube voltage without regard to the thickness of the filters involved. This may arbitrarily necessitate the use of filters which are too thin to permit of proper handling and protection from damage. Moreover, with much of the present-day equipment, the tube voltage cannot be measured directly and, even if known, may be misleading since the quality of the radiation is so strongly dependent upon whether the filament is biased or whether the wave form is constant, pulsating, etc.

It is recommended, therefore, that the limits of the application of any particular filter be specified in terms of the half value of the radiation and hence, indirectly, in terms of the filter material. In any case, the lower limits to the filtration should not be taken below those thicknesses for a particular material, where it can be safely handled without possible damage, or below which its thickness can be made and measured within a maximum error of ±2 per cent.

Accordingly, the following limits and filter materials are recommended:

For qualities measured in h.v.l.—

Use Cellophane up to h.v.l. = 2 mm., above which
Use Aluminum up to h.v.l = 2 mm., above which
Use Copper up to h.v.l. = 2 mm., above which
Use Tin up to h.v.l. = 2 mm., above which
Use Lead, for all h.v.l.

For treatment, any of the above filter materials may be used, when properly followed by filter material of lower atomic number, as follows:

Primary Treatment Filter	*Secondary Filter*
Lead	1.5 mm. tin + 0.25 mm. copper + 1 mm. aluminum
Tin	0.25 mm. copper + 1 mm. aluminum
Copper	1 mm. aluminum
Aluminum	None
Cellophane	None

The secondary filters shall be added between the primary filter and the patient in the order shown, *i.e.*, in the order of decreasing atomic number. In other words, the use of any filter of heavier atomic number than aluminum requires the addition of a minimum thickness of the next specified filter material, between it and the patient.

2. *Scope of the Committee's Activities.*—The question was raised by a member of our Committee as to whether it was within the Committee's province to deal with any matters other than those relating directly to standards

and units. Present at the discussion were several members of the Committee who have served actively since its inception about twelve years ago, including its originator and first chairman. It was brought out that our originally intended function was not only to foster the adoption of units and the establishment of standards but to consider and make reports on all physical problems relating to the application of x-rays and assist in the education of the radiologist on the use of physical methods in his clinical problems.

It was decided that future reports of the Committee be in three separate categories:

(*a*) The "shall" category, which represents adopted things, things which the Committee believes are established beyond all reasonable doubt;

(*b*) The "should" category, representing recommended procedures, methods, etc., which, though not obligatory, appear to be most desirable at the time; and

(*c*) The "permissible" category, pertaining to things not harmful, but upon which the Committee does not wish to take stronger action.

Regarding the American Medical Association proposals for x-ray equipment standardization and performance standardization, the Committee wishes to go on record as being positively opposed to the recognition of any laboratory as the sole agent of establishing such standards. It feels that any such establishment of standards should come through some suitably representative body which can be in a free position to judge the merits of any related investigations carried out either by its request or by some independently operating laboratory.

3. *Use of the Term "Roentgen."*—The Committee approved the use of the "roentgen" as a unit for the specification of x-rays traversing a region in any material, *e.g.*, air or tissues, etc., at any point. It would recommend, however, that it should be clearly indicated whether the specified number of roentgens refers to total, primary, or secondary radiation. The interpretation of a stated quantity of roentgens in any material is based, according to present usage, on the principle that equal numbers of ergs per square centimeter of x-radiation of a particular spectral distribution are specified by the same number of roentgens regardless of the material traversed.

4. *Depth Dose and Back-scattering Data.*—A proposal was made that the Committee adopt some specific data regarding depth dose and back-scattering as a function of voltage, field size, filter, etc. It was decided to collect and review critically the available data and prepare therefrom suitable tables and charts for use by the radiologist, without formally adopting them. A sub-committee, consisting of Dr. Laurence and Dr. Quimby, was appointed to carry out this task. This work has been largely completed and is to be published in the Journal at an early date. Reprints of this report will be obtainable through the Secretary, Dr. Donald S. Childs, in accordance with instructions given at the end of the report.

5. *Timers for X-ray Treatment.*—The Committee's attention was directed to the fact that in many cases, timers for therapy were not sufficiently accurate for the shorter treatment intervals. The following tentative recommendations were agreed upon:

(*a*) Timers shall be accurate and permit of setting within 2 per cent of any part of the scale for which they will be used, down to intervals of two minutes.

(*b*) For intervals below two minutes, single-cycle timers shall be used.

(*c*) Present use of timers not meeting the above requirements is to be condemned.

(d) Any starting and stopping devices shall be positive in their action.

(*e*) Timers shall be checked frequently.

(*f*) Short, high dosage rate treatments should be hand-timed in addition to any electrical or mechanical timing.

Use of recording timers was suggested to avoid "blunders" in recording treatment factors.

It was also suggested that the Time Section of the National Bureau of Standards be approached to assist in the testing of timers. (This has been done and has met with favorable response.)

A sub-committee under Dr. Weatherwax was appointed to follow the question through.

6. *Need for Standards in Diagnostic Field* (Dr. Henny).—It can be shown that a properly exposed roentgenogram which has great photographic contrast and the highest degree of shadow sharpness will contain more information of the part under investigation than a roentgenogram which is under- or over-exposed and has a lower degree of contrast. Because of personal idiosyncrasies many roentgenologists will prefer a roentgenogram lighter or darker than this "ideal" standard. It appears, however, that more and more roentgenologists are

becoming satisfied with such an "ideal" roentgenogram. It is probable that the individual likes and dislikes of the roentgenologist, as far as the characteristics of such a roentgenogram are concerned, could be taken care of by varying the intensity of the viewing light. Such being the case, the aim of standards in the diagnostic field would be the production of roentgenograms (*a*) having the greatest amount of detail in the shadows, and (*b*) showing photographic densities which are comparable with corresponding roentgenograms of the patient made in the same or in different roentgen-ray departments at other times.

The unmeasurable variability of different patients and the required degree of photographic latitude must be taken into consideration in planning a standard roentgenogram of a given part. These factors, together with the limitations of the roentgenographic equipment, require in many cases that a compromise be made. The particular roentgenographic factors for each examination can be arrived at with relative ease although it will be impossible to satisfy everyone. A simple factor such as tube–film distance, for example, varies over quite a wide range in different roentgen-ray departments and roentgenologists are prone to resist changes in technic.

The object of standardizing diagnostic roentgenography must be to obtain roentgenograms of standard and superior characteristics, regardless of the roentgenographic or processing equipment employed. Since so many factors (focal spot size, voltage wave form, tube current, intensifying screens, film developing characteristics, etc.) go into making each roentgenogram, it is impractical as well as expensive to standardize each one of these. By making a roentgenogram according to predetermined and proven technical factors of an aluminum stepladder of known specifications, and by processing the film under "standard" conditions in fresh solutions which are available on the market, a standard stepladder film would be available. A roentgenologist wishing to check his diagnostic machine would make roentgenograms of an identical aluminum stepladder using technical factors as nearly like those employed in making the standard as he could. After processing the film according to his routine method, he would cut it so that the ladder step shadows could be placed side by side with those of the standard over an appropriate mask on a viewing box. A close inspection would tell which was darker (faster) and which had the greater contrast. He would then have an idea as to where he stood in regard to the standard. X-ray technical factors, and possible intensifying screens and developing solution, would have to be changed until the test film was equal to the standard. It would still be necessary to measure the x-ray tube focal spot size and to test for intensifying screen grain and contact. The focal spot size may be determined from a pinhole picture and the intensifying screens are tested by a roentgenogram of a fine wire (No. 26) mesh which is placed directly on top of the cassette. From these findings, together with the tube–film distance used in roentgenography, the geometrical unsharpness can be estimated and it may be found whether or not this is within some arbitrarily set standard. Use of a small test aluminum ladder placed on the corner of the cassette beside the patient has been suggested. The shadows of this ladder, as shown on the film, may be compared from time to time with those on films taken previously to determine the status (as far as speed and contrast are concerned) of any roentgenogram. If the roentgenogram is sent to another roentgenologist, the latter, when making a roentgenogram of the same patient, may learn to judge the technical factors to be used by comparing the ladder shadows with those of a duplicate ladder on his own films. He would then obtain a roentgenogram of essentially the same density and contrast as those of the other films, and all the clinical roentgenograms could be directly compared.

7. *Listing of X-ray Physicists.*—The following names have been added to our lists.

December, 1938.

L. B. Leppard, Department of Health, Ottawa.
S. S. Sidhu, University of Pittsburgh.
J. E. Morgan, Duke University.
B. R. Stephenson, Buffalo City Hospital.

December, 1939.

Dallet B. O'Neill, Philadelphia.
S. Reid Warren, Philadelphia.

The name of J. D. Leitch, Canada, is removed from the lists without prejudice. He is now associated with a commercial concern.

The Committee agreed upon the following:

(*a*) All radiologists should seek calibration advice from a listed physicist before undertaking their own calibration work.

(*b*) The radiologist should be encouraged to get advice from a listed physicist regarding the

calibration and protection of any new equipment in advance of its purchase and installation.

(*c*) The Committee reaffirms its stand against the dosage calibration of x-ray equipment by manufacturers or their regularly employed agents. Any calibration by a manufacturer (for specification purposes) shall be considered as provisional, and shall be checked as soon as possible by a listed physicist.

(*d*) All dosage calibration shall include a statement or estimate of the inherent filtration of the tube and housing.

8. The following is the complete listing of x-ray physicists:

Blatz, I. H., Dept. of Hospitals, 414 E. 26th St., New York City.
Braestrup, C. B., Dept. of Hospitals, City of New York.
Cole, K. S., College of Physicians and Surgeons, New York City.
Corrigan, K. E., Harper Hospital, Detroit, Mich.
Demers, J., University of Montreal, Montreal, Canada.
Exner, F. M., Crocker Institute, New York City.
Failla, G., Memorial Hospital, New York City.
Glasser, Otto, Cleveland Clinic, Cleveland, Ohio.
Harrington, E. L., Univ. of Saskatchewan, Saskatoon, Canada.
Henderson, G. H., Dalhousie University, Halifax, Nova Scotia.
Henny, G., Temple University Hospital, Philadelphia.
Jacobson, L., Montefiore Hospital, New York City.
Laurence, G. C., National Research Council of Canada, Ottawa.
Lauritsen, C. C., California Institute of Technology, Pasadena, Calif.
Landauer, R., 1317 Judson Ave., Highland Park, Ill.
Leppard, L. B., Department of Health, Ottawa, Canada.
MacDonald, P. A., Cancer Institute, Winnepeg, Canada.
Marinelli, L. D., Memorial Hospital, New York City.
Morgan, J. S., Duke University, Durham, N. C.
Mutscheller, A., Post-graduate Hospital, New York City.
Nurnburger, C. E., Redmon, Ill.
Omberg, A. C., Vanderbilt University Hospital, Nashville, Tenn.
O'Neill, Dallet B., Moore School X-ray Laboratory, Philadelphia.
Pugh, R. E., 1944 Summit Avenue, Pasadena, Calif.
Quimby, Edith H., Memorial Hospital, New York City.
Reinhard, M. C., State Institute for Study of Malignant Disease, Buffalo, N. Y.
Robertson, J. K., Queens Univ., Kingston, Ont.
Rose, J. E., Marine Hospital, Baltimore.
Rovner, L., Ryerson Laboratory, University of Chicago, Chicago, Ill.
Schwarzschild, M. M., Beth Israel Hospital, New York City.
Shrum, G. M., University of British Columbia, Vancouver, B. C.
Sidhu, S. S., University of Pittsburgh, Pittsburgh, Pa.
Singer, G., National Bureau of Standards, Washington, D. C.
Stenstrom, W., University of Minnesota, Minneapolis, Minn.
Stephenson, B. R., Buffalo City Hospital, Buffalo, N. Y.
Taylor, L. S., National Bureau of Standards, Washington, D. C.
Ulrey, C. T., Bloomfield, N. J.
Vigness, Irwin, University of Minnesota, Minneapolis, Minn.
Warren, S. Reid, Moore School X-ray Laboratory, Philadelphia.
Weatherwax, J. L., Philadelphia General Hospital, Philadelphia.
Williams, M. M. D., Mayo Clinic, Rochester, Minn.

Submitted by the Committee.

Lauriston S. Taylor, *Chairman*
U. V. Portmann, *Sub-chairman*
Edwin C. Ernst
W. Edward Chamberlain
Robert R. Newell
Arthur W. Erskine
Robert B. Taft
Richard Dresser
Otto Glasser
Edith H. Quimby
W. Stenstrom
J. L. Weatherwax
George C. Laurence
George C. Henny
Kenneth E. Corrigan

IN MEMORIAM

James W. Hunter, M.D., of Norfolk, Virginia, died May 11, 1940. Dr. Hunter had been in failing health for some time.

George C. McElfatrick, M.D., of Wilmington, Delaware, died on March 20, 1940. Dr. McElfatrick was Counselor for the State of Delaware.

Martin T. Powers, M.D., died June 15, 1940, of coronary thrombosis, in St. Elizabeth's Hospital, Utica, N. Y., aged 60 years.

Dr. Powers, a pioneer x-ray specialist in Central New York, was born in Oxford, N. Y., and was graduated from the College of Physicians and Surgeons, Columbia University, in 1905. After serving in the Jamaica Hospital he practised in Westernville and Rome, removing to Utica in 1921. He was past president of the Utica Academy of Medicine, member of the Medical Society of the State of New York, the American Medical Association, the Radiological Society of North America, a diplomate of the American Board of Radiology, and Chairman of the Section on Radiology, Medical Society of the State of New York.

BOOKS RECEIVED

Books received are acknowledged under this heading, and such notice may be regarded as an acknowledgment of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

CLINICAL ROENTGENOLOGY OF THE ALIMENTARY TRACT. By JACOB BUCKSTEIN, M.D., Visiting Roentgenologist (Alimentary Tract Division), Bellevue Hospital; Consultant in Gastro-enterology, Central Islip Hospital, New York. A volume of 652 pages, with 525 illustrations. Published by W. B. Saunders Company, Philadelphia, 1940. Price: $10.00.

STATISTICAL REPORT ON THE RESULTS OF RADIUM THERAPY IN THE TREATMENT OF MALIGNANT DISEASE. Five-year statistical report of the Christie Hospital and Holt Radium Institute, Manchester, England, for the years 1932 and 1933 assessed at five years. Containing 100 pages. Published by Rowland Berry & Co., Ltd., Stockport, England, 1939. No price stated.

BOOK REVIEWS

THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE ESOPHAGUS. By PORTER P. VINSON, B.S., M.A., M.D., D.Sc., F.A.C.P., Professor of Bronchoscopy, Medical College of Virginia, Richmond, Virginia. A volume of 224 pages, with 98 illustrations. Published by Charles C. Thomas, Springfield, Illinois, 1939. Price: $4.00.

Dr. Vinson has presented for the first time a book devoted solely to the diagnosis and treatment of lesions of the esophagus. He begins his monograph with a discussion of the approach to the problem of obstructing lesions of the esophagus and an outline of their general management. His second chapter is devoted to esophagoscopy. He discusses the choice of instruments and technic and the indications and contra-indications for the procedure.

The remainder of the book is devoted to a consideration of the individual affections of the esophagus. Organic obstructing lesions including carcinoma, cicatricial stricture, and congenital stricture are considered at length. A chapter is devoted to cardiospasm, spasm at the cardia, and diffuse spasm of the esophagus. An account is given of esophageal diverticula, with particular attention to the more common pharyngo-esophageal diverticulum. The functional syndromes including hysterical dysphagia, globus hystericus, and functional dysphagia are differentiated and their management outlined. A section is devoted to injuries and perforations of the organ. A brief consideration is given to the rarer lesions of the esophagus, particularly benign tumors, fungus infections, syphilis, and tuberculosis. Non-specific esophagitis is discussed as a common esophageal lesion seldom recognized clinically. A chapter is concerned with the important problem of esophageal foreign bodies and their treatment. The various forms of supradiaphragmatic stomach and the neurologic lesions affecting the act of deglutition are considered briefly, although the author does not consider them as primarily esophageal problems. A concluding chapter offers a brief résumé of the present status of gastroscopy.

The author stresses the necessity for complete investigation of every case of esophageal disease. The book is liberally illustrated with roentgenograms, pathologic specimens, and diagrams. The need for caution in esophageal instrumentation is emphasized and it is repeat-

edly pointed out that all esophageal dilatations must be carried out over a previously swallowed silk thread. For the most part, Dr. Vinson has limited his discussion of therapy to the methods that he himself employs. Experience with more than 3,000 instances of esophageal disease qualifies him as an authority on these problems.

WIDE FIELD X-RAY TREATMENT: THE VALUE OF THE X-RAY BATH METHOD IN DISEASE AND HEALTH. By S. GILBERT SCOTT, M.R.C.S., L.R.C.P., F.F.R., D.M.R.E. (Camb.), Consulting Radiologist to the London Hospital; Honorary Radiologist to the British Red Cross Rheumatism Clinic, London; Honorary Physician-radiologist to the Charterhouse Rheumatism Clinic. A volume of 78 pages, illustrated with tables, photographs, and colored plates. Published by George Newnes, Ltd., London, 1939. Price: 8/6.

This book is an elaboration of a paper previously published in the *American Journal of Roentgenology and Radium Therapy*[1] on the medical use of x-rays in the manner of stimulating natural means to effect a cure. Even though the author's ideas may seem fantastic, and to interpret them we must radically change some of our own ideas of the accepted biologic effects of x-rays, the method as modified by Teschendorf, Heublein and others has had a definite, if limited, clinical application. Even though his results are not well documented, one is inclined to agree with the author that his idea is worth thinking about and that perhaps the method is worth a serious trial.

[1] Scott, S. G.: Wide Field Roentgen Therapy, with Report on Clinical Investigations, 1920–1938. Am. Jour. Roentgenol. and Rad. Ther., **43**, 1–16, January, 1940.

PNEUMOCONIOSIS (SILICOSIS): THE STORY OF DUSTY LUNGS. A PRELIMINARY REPORT. By LEWIS GREGORY COLE, M.D., and WILLIAM GREGORY COLE, M.D., John B. Pierce Foundation, New York City. Published by John B. Pierce Foundation, New York City, 1940.

In the authors' inimitable manner, there is here presented an original and certainly unorthodox discussion of an extremely important problem. This little book contains a general introduction to the subject of pneumoconiosis, a study of the pathology by a new method, a discussion of the roentgen diagnosis, and some data on the social and economic phases. Bound together with this are the reprints of two articles by the authors, one of which appeared in RADIOLOGY, the other in the *Journal of the American Medical Association*. These are concerned with the pathology of pneumoconiosis and the causes of dyspnea in this condition. There is no effort here to cover the subject of dust diseases in comprehensive fashion. The authors present rather their own ideas, many of which are new, of the pathogenesis of this disease. They believe that cases of pneumoconiosis may be classified into four groups: in three of these the roentgen findings commonly are out of proportion to the symptoms or disability; in the fourth, the acute type of silicosis, the roentgen findings are very minor while the symptomatology and disability are very severe. The authors are particularly concerned with the failure of the profession to recognize the latter group. Numerous statements in this book may well be challenged and will need much more elaboration and proof before they are accepted. Nevertheless, the material presented is stimulating and thoroughly worth-while reading.

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ANIMAL EXPERIMENTATION

A Study on the Action at Distance of Inflammation on the Growth and Radiosensitivity of Malignant Tumor. S. Sasaoka. Jap. Jour. Obst. and Gynec., **22,** 56–85, March, 1939.

The author transplanted Kato's rabbit sarcoma to normal rabbits and found by experiment that inflammation affects the growth of the sarcoma, irrespective of the physical or the chemical inflammation, and irrespective of transplantation in the inflammation fossa or occurrence of inflammation adjacent to the sarcoma transplanted. The chemical inflammation, however, had, by far, the greater growth-retarding effect. The retarding mechanism is considered to be due to various factors, such as acceleration of protoplasma activation, leukocytosis, phagocytosis, nechrohormone-like substance due to fusion of abscess, anti-tumorous substance due to leukolysis, and acceleration of the reticulo-endothelial system.

WILLIS A. WARD, M.D.

Tumor Induction and Tumor Growth in Hypophysectomized Mice. Remmert Korteweg and Frédérick Thomas. Am. Jour. Cancer, **37,** 36–44, September, 1939.

A brief review of the literature on this subject is given. The authors' work consisted of transplanting tumors in hypophysectomized mice and also producing new tumors in similar mice. These animals were then compared with a control series in which the pituitary was intact. Transplantation of the tumors was successful in every case but the tumors grew more slowly in hypophysectomized animals. However, the relation of the final tumor weight to the body weight of the control animals and those operated upon was the same. Induced tumors appeared markedly later in the hypophysectomized mice than in the controls. Any differences which were noted were quantitative, not qualitative.

HAROLD O. PETERSON, M.D.

APPARATUS

The Photography of the Fluoroscopic Image: Single Exposure and Roentgen Cinematography. Robert Janker. Röntgenpraxis, **11,** 271–284, May, 1939.

The photography of a fluoroscopic image is a reasonably well developed and practical method of getting a single exposure or a moving picture of organs of the body.

Further technical improvements seem to lie in the direction of quality of film material and better fluoroscopic screens.

In spite of a considerable amount of work, fluoroscopic screens could be improved upon in two ways. For example, "lagless" screens without any afterglow would be most desirable for roentgen cinematography. There is, at present, some difficulty in that field, especially when high intensities are used. The author incited the fluoroscopic screen first with the shutter of the camera closed; he opened the shutter only at the moment at which he turned off the x-ray current which incited the fluoroscopic screen. He succeeded in getting a photographic image of the screen after the current was turned off in many instances. For successive short photographic exposures, as are needed for cinematography, it is necessary to obliterate this phenomenon insofar as is possible. On the other hand, it would be a tremendous improvement if the afterglow of the screen could be used for a single photographic exposure. One could thus make extremely short exposures without the haziness caused by motion.

Possibilities of improvement are still inherent in film material. Photographic film and fluoroscopic screen should, so to speak, be much better harmonized than is possible at present. The author believes that fluoroscopic screens with a blue fluorescence will be more important than those in use to-day.

Another need for this work is the creation of a special film with an especially steep gradation.

It is the author's hope that further technical improvements will simplify the method of screen photography and permit a more general use of this promising procedure.

HANS W. HEFKE, M.D.

Devices for Maintaining Constant the Output of X-ray Tubes. D. E. Lea. British Jour. Radiol., **12,** 359–363, June, 1939.

The methods that are used in the Strangeways Laboratory for stabilizing the output of x-ray tubes are described. For use with hot cathode tubes, a main voltage stabilizer and a filament current regulator are described and the wiring diagrams given. The filament current stabilizer is controlled by the ionization in the beam and is accurate within 1 per cent. The main voltage regulator is capable of regulation by three-volt steps in the primary, over a range of 18 volts above or below standard voltage. An automatic pressure regulator for ionic tubes is also described.

SYDNEY J. HAWLEY, M.D.

Scattered Radiation and Variation of Roentgen Output of X-ray Generators in Practice. Wilhelm Stenstrom and Irwin Vigness. Minnesota Med., **22,** 517–520, August, 1939.

The authors point out that, in calibrating generators, it is frequently noted that protective measures are neglected with those units used for superficial therapy (up to 140 kv.p.). Many of these generators have not been calibrated since the date of their installation, which may have been some years ago.

It is recommended that these units be calibrated at least once a year, and after any change of tube or adjustment.

X-radiations were measured with a Victoreen roentgen meter. A large ionization chamber used with this meter was employed to measure the intensity of radiation at a position near the control stand. The chamber

was left in this position during most of the time that the generator was being calibrated. The intensity of radiation near the control stand will be greater if there is no primary filtration and will be less if the primary beam is heavily filtered.

As 0.1 roentgen is considered the maximum safe daily dose for a person working with x-rays, a machine used five hours a day is not considered safe if the exposure exceeds 0.0003 r /min.

Much greater proportionate respect is usually given to the protection from hard than from soft x-rays.

Without exception, the superficial tubes included in this survey were housed in open lead glass bowls. All were air-cooled universal type Coolidge tubes. In the cases in which the intensity of radiation at the control stand was more than 0.01 roentgen per minute, the control stand was located in the same room as was the x-ray generator. In some cases the control stand supported a thick plate glass behind which the operator stood. This glass and the control stand offered a measure of protection from the direct radiation but gave little protection from the scattered radiation.

The use of a closed lead glass bowl or shock-proof assembly is strongly recommended. Direct and scattered radiation may arise from x-rays penetrating the arms of the x-ray tube and perhaps the lead glass bowl. If a control stand cannot be removed from the x-ray room it should be enclosed in a booth lined with lead or with material equivalent to from 1.5 to 2.0 mm. of lead, for voltage from 150 to 200 kv.p.

Fluoroscopy tables should be grounded; lack of this and slack in flexible conductors between rheophores and tube terminals caused the death of a North Dakota physician about two years ago.

When a patient is placed between exposed high tension and a table or stand as in most superficial machines, the table or stand should be made of dry wood, or some such insulating material, and insulated from the ground so that the patient will not form a conducting path between the high voltage and the ground.

Tube output shows wide variation; in some calibrations at 100 kv. and 5 ma., with 12-inch T.S.D., no filter, the r output varied from 85 to 155 per minute. With a filter of 1 mm. Al, the variation was greatly reduced.

Many tables are appended showing the results of calibration of various units.

PERCY J. DELANO, M.D.

THE APPENDIX

Mucocele of the Appendix, with Report of Twelve Cases. James C. Doyle. Western Jour. Surg., Obst., and Gynec., **47,** 515–521, September, 1939.

The author reports 12 cases of this rare condition found in a series of over 10,000 appendectomies over a 13-year period. Six cases were in men, six in women. None was diagnosed correctly pre-operatively. The symptomatology may be very confusing or indefinite, and, if a mass is felt, in a female especially, it may be considered adnexal in origin. The development of this condition depends on: (1) Obliteration of the appendiceal lumen at one or more points; (2) absence of gross infection; (3) mucus-secreting cells, which secrete at a faster rate than absorption takes place; (4) distensible wall.

The author refers to only two cases in the literature in which a diagnosis was made roentgenologically but he does not give the criteria for such a diagnosis. The treatment is surgical. Possible pseudomyxomatous peritonitis may result from spilling of the mucous content into the peritoneal cavity.

SIMON POLLACK, M.D.

X-ray as an Aid in Diagnosis of Chronic Appendicitis. Lucius D. Hill, Jr. Southern Med. Jour., **32,** 391–397, April, 1939.

Asymptomatic chronic appendicitis in childhood is considered one of the causes of chronic malnutrition and general ill health. Five cases are reported in which other conditions were excluded and in which the history, examination, and laboratory work failed to suggest pathology of the appendix. The diagnosis of chronic appendicitis was made following barium enema and confirmed by the pathologic diagnosis and subsequent clinical improvement.

The significant x-ray findings were tenderness in palpation over the visualized appendix, fixed position of the appendix, and prolonged barium retention in the appendix. Normal children showed either no filling of the appendix or filling and emptying either with or immediately after the cecum. Roentgenographs were made at the time of the enema and at four-, six-, and 24-hour intervals, with further plates if necessary, to determine the time of emptying.

JOHN M. MILES, M.D.

ARTHRITIS

Environmental Factors in Rheumatoid Arthritis: A Study of the Relationship between the Onset and Exacerbations of Arthritis and the Emotional or Environmental Factors. Stanley Cobb, Walter Bauer, and Isabel Whiting. Jour. Am. Med. Assn., **113,** 668–670, Aug. 19, 1939.

Rheumatoid arthritis is a chronic disease of unknown etiology. It respects neither age, sex, race, nor social position, although it does affect women more frequently than men, white persons more often than Negroes, and the poor more commonly than the rich. In addition to the articular involvement, which is usually symmetrical and more likely to affect the small joints first, the patients complain of constitutional, vasomotor, and neurologic symptoms. These associated symptoms frequently precede those referable to the skeletal system and in many instances persist throughout the course of the disease.

Rheumatoid arthritis may be unrelentingly progressive from the onset but is more commonly characterized by remissions and relapses of varying degree and duration. In a small percentage of cases the remissions are complete and of years' duration; in the majority they are incomplete and short lived with re-

current symptoms and telltale evidence of previous fascial or joint involvement persisting.

Irrespective of the initial course of the disease, increasing evidence of progression occurs with the passing of time, leading in many instances to partial or complete incapacitation.

Studying the patient as a biologic unit, specific examples were recorded in which rheumatoid arthritis came on immediately after some disturbing emotional experience. Environmental stress, especially poverty, grief, and family worry, seem to bear more than a chance relationship to the onset and exacerbations of rheumatoid arthritis in a detailed psychiatric study.

CHARLES G. SUTHERLAND, M.D.

BONES, DISEASES (DIAGNOSIS)

Mélorheostose Léri: A Case of Bilateral Localization of the Hyperostotic and Osteosclerotic Processes in the Pelvis and Lower Extremities. K. J. Bury. Röntgenpraxis, **11,** 292–299, May, 1939.

To the 27 cases of melorheostosis recorded in the literature, a new one is added by the author. It is unusual because of the bilateral localization of the hyperostotic and osteosclerotic changes.

After a discussion of the differential diagnosis and of the previously reported cases, all the factors are considered which do not conform to the thesis of unilateral involvement of the extremities. The relatively frequent occurrence (21.5 per cent) of an abnormal bilateral involvement seems to indicate to the author that one should not adhere too strictly to the absolute rule of unilateral occurrence stated by Léri. One must admit the possibility of exceptions to this rule.

HANS W. HEFKE, M.D.

Increased and Decreased Density of Bone, with Special Reference to Fibrosis of the Marrow. H. A. T. Fairbank. British Jour. Surg., **27,** 1–33, July, 1939.

This is a very comprehensive paper describing a number of pathologic conditions of the skeleton and attempting to show that the presence of fibrous tissue in the medullary spaces is a feature, and may be the precursor of ossification in several of these conditions. The various conditions are discussed under two headings: generalized osteoporosis and increased density of bone.

GENERALIZED OSTEOPOROSIS

Osteogenesis Imperfecta Cystica.—In this condition the marrow spaces are filled with loose myxomatous-looking fibroid tissue with many vessels. The x-ray appearance is characterized by cystic changes in the bones, tri-radiate pelvis, and curved femora. Calcium and phosphorus readings are normal, but blood phosphatase is elevated.

Infantile Scurvy.—Decalcification of the bone is general in infantile scurvy, but is most marked at the end of the metaphysis. The dense line next to the epiphyses represents a calcified cartilage matrix. Histologically, the marrow cavity is filled with a "loose embryonic-like connective tissue" and a few marrow cells.

Osteomalacia.—This condition is regarded as dietetic in origin and shows a general osteoporosis with abundance of poorly calcified osteoid tissue which itself may undergo complete decalcification.

Cœliac Rickets.—The changes in the bones are of two kinds: rachitic disturbance of the epiphyseal lines and general osteoporosis. Ossification of the epiphyses may be delayed both at its commencement and completion.

Renal Rickets.—There is a partial or complete failure of the normal proliferation of cartilage cells and an absence of proper cartilage columns. The formation of bone is limited, and the area which should be occupied by calcified cartilage and recently formed bone trabeculæ is occupied by fibrous tissue. It is obvious that growth in length of the bone must have ceased completely, if the changes are at all advanced.

Senile Osteoporosis.—Although the whole skeleton is affected to some extent, the vertebral bodies show the most striking loss of density.

INCREASED DENSITY OF BONE

Lines of Arrested Growth.—These are the transverse lines so commonly seen in the metaphyses of the long bones in children. They result from the arrest of the formation of the longitudinal trabeculæ and concentration of the transverse trabeculæ.

Diffuse Fibrosis of Bone.—In this condition we have three pathologic changes: fibrosis of pre-existing marrow, replacement of bone by fibrous tissue, and conversion of fibrous tissue into bone, all of which may be found, to a varying degree, in a single case. Two cases are reported, both of which show fibrosis of bone progressing from a porotic to a petrosic condition.

Generalized Diffuse Fibrosis of Bone.—This condition affects multiple bones and is characterized by enlargement of the shaft of long bones with streaks of increased density. Histologically, the cortex is dense and thickened, and the cancellous bone spaces are filled with cellular fibrous tissue.

Melorheostosis.—This very rare disease differs from ordinary "marble bones." The distinguishing features are: (1) The changes are confined to the bones of one limb; (2) the outline of an affected bone is definitely distorted; (3) the presence of pain, occasionally severe, and (4) limitation of movement in the joints formed by the affected bones.

Generalized Osteopetrosis (Albers-Schönberg Disease).—The chief features of the syndrome are abnormal density of most of the skeleton, anemia which may be severe and fatal, and optic atrophy. The bones usually resemble marble, but may be more chalky and fragile.

Leontiasis Ossea.—In its diffuse form, leontiasis ossea is the same as diffuse fibrosis of bone, with the histologic picture quite similar.

Osteopoikilosis.—This condition is characterized by large numbers of dense spots in long and short bones.

The skull, vertebræ, and ribs are alone almost exempt. The spots are entirely asymptomatic and are usually accidently discovered.

Osteitis Deformans.—In this condition, as in others in which fibrosis of the marrow is a prominent feature, the roentgenographs reveal either decreased or increased density, and not uncommonly a combination of both.

Secondary Growths.—Radiologically there are four types of bone metastases, as follows:

(1) Osteolytic without bone reaction (breast or hypernephroma).
(2) Cyst-like, with formation of surrounding shell (hypernephroma or thyroid).
(3) Pagetoid (breast or prostate).
(4) Purely osteoplastic (prostate).

In the last there is greatly increased density, resembling "marble bones." On section the small spaces in the fine-mesh new-formed bone are filled by malignant growth instead of fibrous marrow.

MAX CLIMAN, M.D.

Myositis Ossificans Progressiva. Giuseppe Bignami and A. Runco. Arch. di Radiol., **15,** 125–190, May-June, 1939.

In a 63-page article, supplemented by two pages of bibliography, the authors discuss progressing ossifying myositis quite exhaustively and present one case in detail.

E. T. LEDDY, M.D.

Hereditary Osteochondrodystrophia Deformans: A Family with Twenty Members Affected in Five Generations. A. Wilmot Jacobsen. Jour. Am. Med. Assn., **113,** 121–124, July 8, 1939.

The term "osteochondrodystrophy" describes a developmental disease of the skeleton which produces many different clinical pictures. It is a defect, often familial, in the orderly growth of ossifying cartilage, which may result in almost complete arrest or in any degree of partial arrest of endochondral ossification. The resulting deformities will depend on what pattern the perverted cartilage growth follows.

Conditions doubtless belonging in this complicated group of congenital osseous dystrophies have been described under such titles as familial osteochondrodystrophy, dyschondroplasia fetalis, chondrodysplasia, osseous dystrophy, atypical achondroplasia, rachitic chondrodystrophy, dysostosis multiplex, osteodystrophia fibrosa, chondrodystrophic rheostosis, congenital perversion of growth, ecchondrodysplasia, Hurler's disease, gargoylism, and familial rickets.

In many of the cases reported changes in the shape of the vertebral bodies have been noted.

The author reviews the study of a family with 20 members affected in five generations. The four cases reported were of the type commonly referred to as Morquio's disease. This was characterized by changes in bodily conformation resulting from shortening of the spinal column and of the necks of the femurs. The patients were moderately dwarfed, with pigeon breast, kyphosis, and compensatory lordosis. Because the narrowing of the vertebral bodies included those of the cervical region, the neck was so short as to seem absent, and the head, although of normal size, appeared large.

Changes in the pelvic bones and the upper ends of the femur caused the patient to stand in a semi-crouching position. The joints were restricted in motion, and the gait was stiff. Other than the skeletal defects there were no organic changes, and the mentality was normal.

CHARLES G. SUTHERLAND, M.D.

THE BREAST

Results of Radical Mastectomy in 5,026 Cases of Carcinoma of the Breast: Various Clinical and Pathologic Factors which Influence the Prognosis. Stuart W. Harrington. Pennsylvania Med. Jour., **43,** 413–427, January, 1940.

An extensive study of these cases was made and the various factors which might influence the prognosis have been subjected to careful statistical scrutiny. From these studies it would appear that there is no sustained advantage, in number of survivals, for the patients who had irradiation. The only groups that appeared to show definitely better results with irradiation were in the three- and five-year periods and in these groups the difference was only 5 per cent.

JOSEPH T. DANZER, M.D.

The Dangers of Employing Thorium Dioxide Solution in Mammography. Donald C. Collins. Canadian Med. Assn. Jour., **40,** 440–442, May, 1939.

Injection of thorotrast into breast ducts for mammography is not a safe procedure unless it is followed by removal of the breast.

There are serious objections to its diagnostic use. Thorotrast remains permanently in the injected subcutaneous tissues and has a high degree of radio-activity. Taft has estimated that the alpha rays emitted are about 10,000 times as toxic to human tissues as the therapeutic rays of radium and that 75 c.c. of thorotrast possessed the gamma-ray equivalent of 1.37 microgram of radium. Thorotrast breaks down into mesothorium and radiothorium. A paint containing mesothorium and radiothorium was accidentally ingested by painters of luminous dial disks by putting the tip of the paint brush in the mouth. A widespread bone destruction occurred about the face that in some cases progressed to an osteogenic sarcoma.

Selbie reported studies in which thorotrast was given subcutaneously to rats and mice. Of those animals living more than one year after the injection, 85 per cent of the rats and 26 per cent of the mice developed a tumor at the point of inoculation. Spindle-cell sarcomas predominated.

Eight instances have been recorded of breasts injected with thorotrast and not followed promptly by mastectomy, and to these the author adds two additional cases. Six months or more after the diagnostic injection of thorotrast, these patients developed a pseudotumor resembling carcinoma. Films showed a

considerable amount of thorotrast remaining. Symptoms were of such severity that mastectomies were performed. Microscopic appearance of the tissue showed a marked foreign-body reaction, areas of necrosis, and hyalinization of the connective tissue.

The author concludes it is highly doubtful if thorotrast gives any more information in diseases of the breast than would be derived from physical examination and biopsy.

M. L. CONNELLY, M.D.

Carcinoma of the Breast in Ukrainian Women. M. A. R. Young. Canadian Med. Assn. Jour., **40,** 476–479, May, 1939.

The author presents his observation on carcinoma of the breast among Ukrainian women during a 15-year period at Lamont, Alberta, Canada. Lamont is contiguous to a large settlement of Slavic people.

Examination of 14,500 Slavic women, 25 years of age and over, revealed one carcinoma of the breast; in 6,200 non-Slavic women of the same age group, 18 carcinomas of the breast were found, or one carcinoma for every 350 women.

Reference to the 1931 Dominion Census, for the Province of Alberta, gave the following figures:

1. Ukrainians, population 55,872; carcinomas 6; 1 case per 9,312.
2. Other Slavs, population 43,942; carcinomas 8; 1 case per 5,432.
3. Remaining peoples, population 631,991; carcinomas 417; 1 case per 1,550.

In attempting some explanation for the low incidence among Ukrainian women, large families, prolonged nursing periods, loose clothing, out-of-door exercise, and pure racial stock were mentioned.

M. L. CONNELLY, M.D.

The Diagnosis and Management of Carcinoma of the Breast. N. Frederick Hicken. Jour. Iowa St. Med. Soc., **29,** 430–438, September, 1939.

The author discusses the uses and value of palpation, transillumination, and mammography in the diagnosis of breast lesions. Mammograms following the injection of contrast material (skiodan viscous) into the ducts, have been found to be of value in the diagnosis of small asymptomatic tumors. The author emphasizes the fact that skill on the part of the surgeon in the performance of the injection is necessary and that much training and study are required of the roentgenologist in order that the resulting roentgenograms be properly interpreted.

If biopsy is done, it is recommended that the entire tumor mass and some adjacent tissue be removed. If the lesion is benign, nothing further need be done; if it is malignant, dissemination has been minimized. If it is necessary to remove only a segment of tumor, this should be taken from the edge of the lesion rather than from the center. In addition to knowing that a tumor is malignant it is necessary to know the type of tumor and the extent of the neoplastic process. No patient should be subjected to a radical mastectomy without a complete roentgenologic study of the skeleton and chest. From the standpoint of treatment, cancer of the breast can be classified, roughly, into three groups, as follows:

1. The tumor is small, still confined to the breast matrix without involvement of the skin, muscles, or regional nodes. Radical operation is indicated and post-operative radiation does not seem to enhance the curability, which will be about 95 per cent at the end of five years.
2. In this group there may be slight involvement of the skin and palpable discrete regional lymph nodes but no evidence of systemic metastases. Intensive pre-operative radiation is given, followed in six or eight weeks by radical operation and later by post-operative radiation. If this régime is employed, from 55 to 57 per cent of the patients will be alive at the end of five years.
3. The inoperable tumors which constitute 45 per cent of all breast cancers. Palliation and not cure should be the therapeutic aim and intensive radiation is indicated. Induction of an artificial menopause by irradiation of the ovaries should be given consideration.

LESTER W. PAUL, M.D.

CALCIFICATION

Ossification in the Anterior Cruciate Ligament. Robert S. Garden. Jour. Bone and Joint Surg., **21,** 1027, October, 1939.

This is an unusual occurrence of heterotopic bone formation and the full case report is made for that reason. The patient had been injured in a Rugby game 14 weeks previously and the roentgenogram showed bridging across of the tibial spines and the lateral view placed this shadow in the center of the joint.

At operation, calcification along the anterior cruciate ligament was found. This was dissected out and the ligament left in place. The injury probably caused hemorrhage into the ligament which later became calcified.

JOHN B. MCANENY, M.D.

Calcification of the Costal Cartilages. John B. King. British Jour. Radiol., **12,** 2–12, January, 1939.

Calcification of the costal cartilages may be regarded as a physiologic, not a pathologic, process. It is rare before the age of 20 years, and increases in frequency and amount with age. There is great individual variation. It begins earlier in males.

The first costal cartilage is different from the others; there is no joint between it and the sternum. It invariably shows true ossification at an early age.

Habitus has no relation to the deposition of calcium.

Attempts have been made to relate the amount of calcification to various disease processes, particularly tuberculosis and arteriosclerosis. The histologic processes involved, however, are quite different, and as similar calcifications are commonly found in young healthy animals, there is no reason to expect any corre-

lation. There may be some relation between long-standing malnutrition and calcification but the evidence is not conclusive.

Histologic examination indicates that the change is that of ossification rather than calcification in a degenerating tissue. Contrary to the generally expressed opinion, calcification begins at the center of the cartilage and proceeds outward. Calcification is, therefore, a misnomer; the process should be referred to as ossification. Chemical analysis of calcified cartilages seems to support this view, as the cartilages show the same chemical composition as bone. It is the author's opinion that these changes are the result of stimulation of the cartilage from the strains produced by the upright posture and the stresses resulting from the constant pull of the respiratory muscles.

Deficiencies or excesses of calcium in the diet, avitaminosis, or parathyroid dysfunctions may account for some of the variations in costal cartilage ossification in different individuals.

S. J. HAWLEY, M.D.

Widespread Subcutaneous Calcifications in the Connective Tissue of the Leg. Gunnar Moberg. Acta Radiol., **20,** 151–169, April, 1939.

Extensive calcifications in the cutis and subcutis of the leg in five elderly women are described. The skin in the involved areas showed various changes, such as edema, atrophy, inflammation, induration, thrombophlebitis, varices, and ulcerations. The calcifications are probably due to circulatory disturbances and concomitant necrotic changes.

The lesions could neither be definitely classified as calcinosis circumscripta nor as generalized calcinosis. The picture was also different from that described by Sandström in peritendinitis calcarea.

ERNST A. SCHMIDT, M.D.

CALCULI

Pre-operative Roentgen Diagnosis of Gallstone Ileus. Robert M. Lowman and Egon G. Wissing. Jour. Am. Med. Assn., **112,** 2247–2249, June 3, 1939.

Pre-operative roentgen diagnosis of intestinal obstruction due to gallstone has only rarely been recorded in the literature. A review of the literature revealed only seven cases in which a definite diagnosis of gallstone ileus was established prior to operation. In reported series of intestinal obstruction, the incidence of gallstone as the causative factor varied from 0.9 to 2.1 per cent. The operative mortality varies between 40 and 50 per cent; most surgeons believe that delay in operating is largely responsible for the high death rate.

X-ray examination may often be advantageously undertaken in order to establish the diagnosis. The scout film may show the stone early, before distention of the loops of bowel has occurred. Fluoroscopic observation and a roentgenograph of the abdomen with the patient in the erect position may furnish evidence of fluid levels or abnormal collections of gas. The barium sulfate meal (great caution should be used in the oral administration of barium) may even demonstrate the fistulous tract between the gall bladder and the bowel. A case is reported in which the diagnosis based on x-ray examination was that of obstruction of the duodenum by gallstones, followed by operation and recovery of the patient.

CHARLES G. SUTHERLAND, M.D.

The Management of Ureteral Calculi. Lloyd B. Greene and Charles C. Altman. Pennsylvania Med. Jour., **43,** 438–442, January, 1940.

In a series of 200 cases of ureteral stone the authors present their results and the various problems which they have encountered.

Stereo examination of the urinary tract with the catheters in place will generally locate the stone; in questionable cases a film made in the upright position may show a calculus that could not be seen in the horizontal position. In 15 cases a stone was passed when no roentgen-ray evidence of its presence could be seen.

The authors warn against the injection of pyelographic media against an impassable ureteral obstruction, believing that this procedure was partly responsible for the death of one of their cases.

Failure of an essentially normal kidney to be visualized by secretory urography due to the presence of a very small stone in the ureter and the determination of its functional status are some of the problems discussed in this paper.

JOSEPH T. DANZER, M.D.

CANCER (DIAGNOSIS)

Bone Metastasis from Primary Carcinoma of the Lung: Report of an Unusual Case. Justin J. Stein. Jour. Bone and Joint Surg., **21,** 992–996, October, 1939.

Stein reports a case of primary carcinoma of the lung with metastasis to the left superior maxilla. This is a rather unusual location for metastasis, although bone metastasis is quite common in primary carcinoma of the lung. The frequency of bone metastasis is given by various authors as being between 14 and 28 per cent and the location, according to frequency, in the ribs, skull, pelvic bones, scapula, and clavicle. Usually the lesions are osteoclastic and must be differentiated from metastatic lesions from carcinoma of the breast, thyroid, kidney, and, occasionally, from melanoepithelioma and Hodgkin's disease.

JOHN B. MCANENY, M.D.

Carcinoma of the Fallopian Tube. Langdon Parsons. New England Jour. Med., **221,** 367–373, Sept. 7, 1939.

Carcinoma of the fallopian tube is considered a rare condition and is unusual probably more because it is misdiagnosed than for any other reason. It has been seen and diagnosed more frequently of late years. It comprises about 0.5 per cent of tumors of the genital tract. It is highly malignant and the survival rate is less than 4 per cent. There are reports of about 350 cases: eight cases are analyzed in this study.

The chief difficulty in diagnosis is the lack of consideration of the possibility of this condition. The condition generally occurs after the menopause but has been known to occur in patients between the ages of 18 and 72 years. Like other cancers, essentially nothing is known of its etiology but a story of sterility or pelvic inflammation is often obtained.

The commonest finding is a sudden, often continuous, onset of bleeding after the menopause. This bleeding calls for a curettage of the uterus which is important and almost diagnostic in its negative information; it will eliminate carcinoma of the cervix and fundus. In carcinoma of the ovary the endometrium is hyperplastic: when atrophic endometrium is obtained, we should suspect carcinoma of the fallopian tube.

Unlike most cancers, pain is an early symptom. It is indefinite in type and location but is referred to the lower abdomen. The pain may be colicky and accompanied by a variable type of vaginal discharge which is thought to be expelled tubal accumulation.

The tumor arises, as a rule, in the outer two-thirds and is often bilateral. The tube wall is invaded late, even after metastasis appears, which occurs by lymphatic dissemination. The cellular pattern is papillary, papillary-alveolar, and alveolar. The important feature of the pathology is to determine whether the tumor is primarily tubal or only secondarily implanted there.

The treatment is immediate surgery with complete and total removal of all pelvic organs, followed as soon as possible by intensive deep x-ray therapy.

This is an excellent study of an important malignant tumor.

JOHN B. MCANENY, M.D.

The Relative Grading of Primary and Secondary Carcinoma. I. A. B. Cathie. British Jour. Radiol., **12,** 94, 95, February, 1939.

Grading was attempted in 67 cases from biopsy of primary tumors about the mouth or genitalia and from regional glands of the same cases. In 34 cases the grading of the primary and the secondary were the same. In 31 cases the primary was less differentiated than the secondary. In two cases the primary was more differentiated than the secondary. From this it is concluded that gradings of the primary and secondary growth bear no constant relation.

SYDNEY J. HAWLEY, M.D.

Advances in the Knowledge and Control of Cancer Ludvig Hektoen. Minnesota Med., **22,** 671–677, October, 1939.

The experimental research in the field of cancer dates from about 1900. It began with the discovery of transplantable cancers in animals. Man has no monopoly on cancers; they occur even in insects. Particularly in the work on mice it has been brought out that heredity plays a part.

Cancer in human twins reveals striking evidences of genetic influences. In a number of cases cancer has developed in twins at the same time, in the same organ, and cancer of the same type.

In 1916, Yamagiwa and Ichikawa, two Japanese pathologists, produced cancer in the skin of rabbits by long painting with tar.

There are cancers concerning the external cause of which there is no doubt. Among these must be mentioned chimney-sweep's cancer of the skin; cancer of the skin in cotton spinners, due to mineral oil, and in tar workers; cancer of the lip in fishermen repairing tarred nets; cancer of the bladder in workers with aniline dyes; cancer of the lung in certain miners; cancer of the bones in workers with luminous paints; x-ray cancer of the skin; cancer of the skin from taking arsenic for long periods.

The National Cancer Institute Act is commented upon at length; likewise the state laws for the control of cancer.

PERCY J. DELANO, M.D.

CANCER (THERAPY)

Report on Medical Progress: Cancer. Grantley W. Taylor. New England Jour. Med., **221,** 779–783, Nov. 16, 1939.

This is a review of the progress in various fields of cancer research and treatment. Various chemicals are still being used in experimental cancer production, as are also hormones and viruses. Recent work on genetics throws doubt on the interpretation of older experiments. Immunization against neoplastic proliferation has succeeded under experimental conditions.

Education of the public and the practising physician is going along in well directed programs but, in spite of this, cancer appears to be increasing in prevalence.

In diagnosis of cancer, roentgenology is an important factor; biologic and chemical tests are not sufficiently accurate.

In the field of treatment, surgery has made but little progress except in technical refinements. Radiation is attaining more recognition and is better grounded, as a result of experience. Local and general refrigeration is an added method of attack on the problem.

Carcinoma of the mouth should be irradiated. In the lip it should be excised with dissection of the neck if possible, and, if inoperable, it should be irradiated.

Thyroid carcinomas should be operated upon, followed by intensive irradiation. Carcinoma of the larynx is probably best treated by irradiation. Irradiation has little to offer in primary cancer of the esophagus and lung. Surgery should give whatever benefit it can.

Interstitial radium treatment of breast cancer is quite successful but results of pre-operative and post-operative irradiation are not, on the whole, convincing. Surgery appears to be becoming more simplified.

Operative treatment of cancer of the stomach is producing better results in experienced hands. New procedures have increased the number of cures in cancer of the colon and rectum.

Schiller's test and the colposcope are helpful in the

diagnosis of cancer of the cervix, in which irradiation is the method of choice with the dose fractionated.

Adenomas of the ductless glands have created much interest lately but more from the point of view of function of the gland than any light they may throw on the etiology of cancer.

JOHN B. MCANENY, M.D.

An Evaluation of the Risk of Biopsy in Squamous Carcinoma: A Clinical Experiment. Ralston Paterson and John R. Nuttall. Am. Jour. Cancer, **37,** 64–68, September, 1939.

A clinical experiment was begun five years ago on a group of patients with superficial carcinomas of the skin and mouth. All cases were treated with radiation, thus eliminating the question of surgical trauma. Every other case was biopsied. The diagnosis in the cases without biopsy was made on clinical findings alone, which is undesirable but necessary for the experiment. There were no metastases in any of the cases when treatment was instituted. The authors had 99 cases with biopsies and 67 cases without biopsy. Of the group with biopsies, 19 per cent developed metastases as compared with 20 per cent of the group without biopsy. It was, therefore, concluded that biopsy does not increase the incidence of metastases in squamous carcinoma of the skin and mouth. A similar experiment for other carcinomas, such as carcinoma of the breast, would be of value.

HAROLD O. PETERSON, M.D.

An Experimental Study on the Effect of Vitamin A on the Growth and Radiosensitivity of Malignant Tumor. Yosikazu Huzita. Jap. Jour. Obst. and Gynec., **22,** 38–48, January, 1939.

The author reports transplanting albino rat sarcoma, albino rat cancer, and rabbit sarcoma and varying the dosage of vitamin A. Both the rate growth and radiosensitivity were found to vary with the body content of vitamin A. A decrease of the vitamin produced a retarded growth and, consequently, a decrease of radiosensitivity, whereas an increase of the vitamin produced the reverse conditions.

WILLIS A. WARD, M.D.

The Differentiation of Surgical and Radiotherapeutic Applications in Cancer Therapy. L. Schönbauer. Strahlentherapie, **65,** 607, 1939.

The author has collected a number of statistics from the world literature dealing with the results obtained in the surgical and radiologic treatment of cancer. He covers skin, cheek, lip, mandible, mouth, tongue, tonsil, palate, thyroid, breast, rectum, uterus, penis, stomach, small intestines, colon, testicle, kidney, and extremities. From this survey it appears that carcinoma of the cheek, mouth, tongue, tonsil, and palate should be treated radiologically, except that the resection of cervical glands has to be considered in some instances. Malignant tumors of the thyroid are irradiated, and carcinoma of the breast is given postoperative irradiation in all stages. Carcinoma of the penis is better irradiated than operated upon. In carcinoma of the uterine cervix, radiation therapy alone is equal to operation. The results of radiation therapy in tumors of the gastro-intestinal canal have not been very satisfactory and patients with such tumors consequently should be referred to the surgeon. The same holds true of the malignant neoplasms of the extremities in which instances amputation offers the best chance for a cure.

ERNST A. POHLE, M.D., Ph.D.

Carcinoma of the Lung Simulating Inflammatory Disease. Emile Holman and Philip Pierson. Jour. Am. Med. Assn., **113,** 108–111, July 8, 1939.

Carcinoma of the lung often presents a clinical picture resembling pulmonary suppuration so closely that an exact diagnosis is possible only by bronchoscopy, exploration, or autopsy. At the present time carcinoma of the lung represents more nearly 10 per cent of all carcinomas, an incidence comparable to carcinoma of the large intestine. Any long unresolved pneumonia or persistent suppuration that does not yield to the usual therapeutic measures should be considered a case of probable neoplasm until proved otherwise.

Six cases were reported in detail to illustrate the ease with which a carcinoma of the lung may masquerade as an inflammatory process.

Recent advances in surgical technic have made lobectomy and hemipneumonectomy successful and, therefore, imperative, wherever possible, in the care of pulmonary neoplasm. Early and exact diagnosis by every available means, including bronchoscopy, repeated roentgenograms, studies with iodized oil, and aspiration biopsy will insure better surgical results.

CHARLES G. SUTHERLAND, M.D.

The Treatment of Superficial Cancer by the "X-ray Caustic" Method. G. J. van der Plaats. British Jour. Radiol., **12,** 353–358, June, 1939.

Only tumors of very few millimeters thickness can be treated by this method, but excellent results may be obtained in these by the use of short distance and soft radiation. The same result may be obtained by the use of ordinary shock-proof apparatus that will allow the use of a short distance. The object of the method is to get sufficient dose into the base of the tumor, with as little as possible in the underlying healthy tissues and with no regard for what the skin gets.

Tables are given showing the depth dose under various conditions.

There is little to be gained by fractionation. The field should be a few millimeters larger than the lesion. A single large dose should be administered.

A dark erythema appears in one or two weeks. Healing is complete in from eight to twelve weeks.

SYDNEY J. HAWLEY, M.D.

The Production of a Beam of Fast Neutrons. Paul C. Aebersold. Phys. Rev., **56,** 714–727, Oct. 15, 1939.

At Berkeley, the use of neutrons from the cyclotron in the treatment of cancer is being explored. This article describes the solution of the problem of attaining a beam of fast neutrons sufficiently collimated for therapy, with sufficient protection to patient and personnel from stray neutrons and gamma rays. The author also describes methods used to measure the intensity (a human skin dose in an hour) and to distinguish fast neutrons from slow neutrons and from gamma rays. It is well known that a mixture of radium and beryllium radiates neutrons. Two hundred pounds of radium so used would be needed to yield a neutron beam such as comes from the cyclotron.

R. R. NEWELL, M.D.

Diffused Skeletal Metastasis in Cancer of the Breast. J. F. Paul Lamarque. British Jour. Radiol., **12,** 321–326, June, 1939.

By "diffused metastasis" is meant metastasis to the skull, spine, ribs, pelvis, and the proximal parts of the extremities. Any lesser involvement is regarded as "multiple metastasis." The author does not think that metastasis is caused by radiation therapy, but that we are seeing more cases with metastasis because our patients are living longer. Diffuse metastasis is uncommon.

The symptoms appear from several months to several years after treatment. In many instances careful questioning will reveal that the patient had suggestive symptoms at the time of operation. The chief symptoms are pain in the back and postural deformities. The course of the disease is often discontinuous.

The x-ray examination has three appearances: diffuse osteolysis, oval to rounded areas of destruction, and a diffuse speckled cottony appearance. The diagnosis is easy when the primary focus is known. Similar x-ray appearances may be found in osteitis fibrosa, Paget's disease, and multiple myeloma.

The immediate response to treatment of such patients is good.

SYDNEY J. HAWLEY, M.D.

Fractional Roentgen Therapy of Advanced Carcinoma of the Cervix with Involvement of the Ureters. H. Kirchhoff. Strahlentherapie, **65,** 579, 1939.

It is a well-known fact that the most common cause of death of patients with carcinoma of the cervix is the obstruction of both ureters followed by uremia. The author found in a series of 152 cases, treated according to the original Coutard method, 20 patients who grew rapidly worse immediately after or even during irradiation. Three illustrative cases are reported in which postmortem examination verified the diagnosis of ureteral obstruction. Since 1933 he has used a simple fractional dose method, administering 400 r per field up to a total dose of from 3,200 to 4,000 r. The anterior, lateral, and posterior areas are exposed in the order named. Kirchhoff reports seven cases which on roentgen examination showed definite hydronephrosis apparently due to beginning ureteral obstruction. X-ray therapy applied according to the author's method brought striking relief to some of these patients. He concludes, therefore, that every woman with carcinoma of the cervix should have a complete genito-urinary study before starting treatment. The presence of mild ureteral obstruction from pressure of pelvic tumor masses should not be considered a contra-indication to irradiation, since x-ray therapy cautiously administered can at least bring palliation. One of the patients treated in this series remained free from symptoms as long as three years.

ERNST A. POHLE, M.D., Ph.D.

THE COLON

Roentgenograms of Perforating Diverticula of the Colon. Axel Renander. Acta Radiol., **20,** 235–240, June, 1939.

The author describes two cases of perforation of colonic diverticula in the region of the sigmoid. The perforation cavities showed barium and gas contrast in the roentgenograms and were of plum and date sizes, respectively. In both cases definite clinical symptoms of colitis were observed, but in both instances spontaneous healing occurred without surgical intervention.

ERNST A. SCHMIDT, M.D.

Covered Perforations in Cancer of the Colon. Axel Renander. Acta Radiol., **20,** 257–262, June, 1939.

While the majority of perforations following cancer of the colon leads to duodeno-colonic fistulæ in the proximal colon and to gastro-colic fistulæ in the distal colon, the author observed two cases in which cancers in the region of the splenic flexure perforated into the retroperitoneal space and produced clinical symptoms resembling perinephritic abscesses. In one of the cases these "covered" paralumbar perforations could be demonstrated by roentgenography.

ERNST A. SCHMIDT, M.D.

X-ray Diagnosis of Infiltrates Due to Perisigmoiditis. Trygve Krogdahl. Acta Radiol., **20,** 241–252, June, 1939.

The author discusses the differential diagnosis between perisigmoiditis (peridiverticulitis) of the colon and cancer of the colon. This differential diagnosis is largely possible by exclusion since the roentgenographic appearance of the infiltrative changes after perisigmoiditis may closely resemble tumor formation.

The diagnosis of cancer is suggested by: (1) A short stenosed area; (2) a sharp delineation of the filling defect across the lumen of the viscus; (3) a distal bulging of the filling defect; (4) a "malignant" relief, with sudden transition into a normal relief pattern at the distal and proximal tumor margins; (5) an irregular and partly indistinct longitudinal contour of the stenosed portion, and (6) absence of colonic diverticula (which form the condition *sine qua non* for the development of perisigmoiditis).

The diagnosis of an inflammatory infiltration (perisigmoiditis) is favored by: (1) A long stenosed area;

(2) a funnel-shaped entrance and exit of the stenosis combined with gradual transition from diseased to normal contours of the viscus; (3) a mucous relief pattern which is characterized by predominantly transverse folds without sharp transitional changes, both proximally and distally; (4) presence of colonic diverticula, especially within the stenosed portion, and (5) an irregularly and deeply dented longitudinal contour of the stenosed area with sharply pointed protrusions and dips.

ERNST A. SCHMIDT, M.D.

CONTRAST MEDIA

Visualization of the Adrenal Glands by Air Injection. Norman W. Roome. Jour. Am. Med. Assn., **112,** 196–198, Jan. 21, 1939.

Insufflation of a gas into the perirenal space was first used for the visualization of the soft parts of the region in 1921.

Adrenal tumors have occasionally been demonstrated by other methods, such as intraperitoneal air injection and intra-arterial injection of colloidal thorium dioxide, but the retroperitoneal technic is more generally useful.

The method consists of introducing a quantity of air into the perirenal fat and filming the area several times during the following 24 or 36 hours.

The technic is described in detail and precautions are advised to avoid injecting air into the kidney.

Stereoscopic roentgenograms are made 6, 12, 18 and occasionally 24 or 36 hours after injection. The most useful are usually those made at 12 or 18 hours.

In the discussion it is suggested that oxygen be used in place of air because of its more rapid absorption.

CHARLES G. SUTHERLAND, M.D.

Allergic Reactions Following Urographic Contrast Injections. K. A. Hultborn. Acta Radiol., **20,** 263–271, June, 1939.

The author reports seven cases of his own, and discusses eight others which have been mentioned in the medical literature, in which, after intravenous injection of the urographic contrast medium, allergic reactions were observed. Among his cases, urticaria and passing edema were observed in three instances; four cases developed severe shock. In some cases the patients presented a history of previous asthma or urticaria attacks. One of the patients showed symptoms of uremia which disappeared after one week. The literature mentions (Tachot) the case of a young French soldier who, a few minutes after injection of perabrodil, died of suffocation apparently due to acute edema of the glottis and lungs.

A number of European preparations are held responsible (jodairal, intron, perabrodil). Before any urographic injection, the patient should be questioned with regard to allergy and idiosyncrasies. In complications, calcium preparations administered intravenously and adrenalin subcutaneously are recommended. Analeptics are advisable in shock, and, in more severe cases, permanent intravenous drip is advocated.

ERNST A. SCHMIDT, M.D.

THE CRANIUM

Non-communicating Cyst of the Septum Pellucidum: With Recovery Following Ventriculography. Nathaniel J. Berkwitz. Minnesota Med., **22,** 402–405, June, 1939.

In the seventeenth century, Sylvius observed in several brains dilatation of the cavum septum pellucidum; Verga, in 1851, discovered a cavity posterior to the cavum septum pellucidum which he suggested naming "the sixth ventricle," now known as the *cavum vergæ*.

By means of ventriculography, Dandy, in 1931, was first able to make a diagnosis of abnormal dilatation of the cavum septum pellucidum and cavum vergæ. He reported two cases in which the cavities were dilated to an abnormal degree, sufficiently to produce compression of the pyramidal tracts, and marked mental symptoms. He stated that ventriculograms, in such conditions, appear to be pathognomonic of congenital cysts of the septum pellucidum and cavum vergæ, and that with operative treatment a permanent cure can probably be expected.

Van Wagenen and Aird suggest a practical classification of dilatations of the cavum septum pellucidum and cavum vergæ, namely, "(*a*) non-communicating, or those that have not established a fistula into the third, or lateral ventricles; (*b*) communicating, or those that have a fistulous communication with the ventricular system; (*c*) secondary or acquired dilatation, communicating in type, where the dilatation is but a part of a superimposed internal hydrocephalus from whatever cause." The non-communicating dilatations may cause such symptoms as are produced by tumors: mental changes, headaches, vomiting, etc. Communicating dilatations do not produce such symptoms, since there is no pressure to occlude the interventricular foramina. Consequently, the conversion of a non-communicating to a communicating dilatation by means of a fistulous opening relieves the patient and brings about a clinical recovery.

A case is reported in which a patient presented marked cerebral symptoms, rapid in development.

Among the diagnostic procedures was ventriculography. For a few days after the ventriculogram was made the patient remained much the same. Then rapid improvement occurred, and the tenth day thereafter, he left the hospital with symptoms almost absent.

From the ventriculograms, at first a tumor rather than a cyst of the septum pellucidum was considered. It was thought that the cyst ruptured through sudden changes in the interventricular pressure at the time of ventriculography.

Three clinical cases had previously been reported, with spontaneous rupture, the writer's case being the fourth.

PERCY J. DELANO, M.D.

External Hydrocephalus. A. E. Harbeson. Canadian Med. Assn. Jour., **41,** 158–162, August, 1939.

Hydrocephalus is caused by obstruction in the ventricular system, the subarachnoid space, or both. Three general causes of obstruction are tumors and other space-occupying lesions, inflammatory sequelæ, and congenital malformations. Usual congenital malformations are atresia of the aqueduct of Sylvius, failure of foramina of Magendie and Luschka to develop, and failure of the subarachnoid space to become patent. Dandy, in referring to lesions causing hydrocephalus, states that the interventricular foramina (of Monro) are commonly occluded by a tumor. Congenital absence of the foramen should be considered as a possibility. He knows of no instance in which a defect of this character has been reported. The author, therefore, believes the case presented is rare and unique.

An infant of three and one-half months suffered recurrent attacks of spastic paralysis of the arms. The circumference of the head was 45 cm.; normal circumference at this age is 37 cm. The patient died at the age of nine months.

Autopsy findings were unusual. The interventricular foramina (of Monro) were closed and did not admit passage of even a fine bristle. Septum lucidum was absent, allowing free communication between the lateral ventricles. A large opening extended from the right and one from the left ventricle to the cortical surface of the right and left fronto-parietal areas. Photographs show that one may "look through the brain." In addition, a small opening was present on the medial surface of the cortex of the right frontal lobe. The skull appeared thin and for most part membranous. Five hundred c.c. of cerebrospinal fluid was present beneath the dura.

The author believes atresia of the interventricular foramina caused first an internal hydrocephalus of the lateral ventricles. Pressure on neighboring cortex increased until openings were made at three points, the right and left fronto-parietal areas and medial surface of left frontal lobe. Free communication with the subarachnoid space was established. One may be justified in considering these defects due to porencephalia. However, in the author's opinion, the defects were produced mechanically. No evidence of cyst formation was present. Absorption of the cerebrospinal fluid in the subarachnoid space did not occur. With increased pressure the arachnoid membrane ruptured and the fluid entered the subdural space. External hydrocephalus resulted and the patient died from increased intracranial pressure.

The author has found no similar condition described in available literature.

M. L. Connelly, M.D.

DERMATOLOGY

The Indications and Contra-indications of Roentgen-ray Therapy in Dermatology. C. Guy Lane. New England Jour. Med., **221,** 769–773, Nov. 16, 1939.

The two prerequisites of irradiation in dermatology are, first, standardization of apparatus and technic and, second, correct diagnosis. Many diseases require irradiation because of its inhibitory effects; other diseases demand destruction. Some conditions need but small weekly doses of irradiation and the dark oily skin tolerates this therapy best.

Hyperidrosis and bromidrosis respond to irradiation at times, but the central nervous system factor is not affected by x-rays. Skin manifestations of leukemias and Hodgkin's disease can be treated. The verrucous type of lichen planus and certain warty growths respond well to from 100 to 200 r, with filtration of 0.5 to 1 mm. Al, administered at intervals of from ten days to three weeks. Nevi and angiomas are best treated by irradiation.

Epilation for ringworm, favus, and sycosis vulgaris must be done carefully—but cautiously, if ever repeated, for fear of atrophy.

Destruction is the aim in the treatment of cancer, which should be biopsied and classified. The dosage is between 2,000 and 2,500 r, divided or at one sitting. Cases may be treated with 1,200 r unfiltered plus 1,200 r through 1 mm. Al at 100 kv., or with 2,000 r through 0.25 mm. Cu and 1 mm. Al at 200 kv., at one sitting.

The itching of pruritus, eczema, lichen planus, and mycosis fungoides is relieved by irradiation. Pain relief in herpes zoster and verruca plantaris is frequently attained by x-ray therapy.

Diseases caused by bacteria and fungi, such as pyogenic infections, localized tuberculosis, blastomycosis, actinomycosis, tinea barbæ, and fungus infections of the hands and feet, respond well to irradiation.

Among contra-indications are unstandardized apparatus, idiosyncrasy, previous irradiation, erythema produced by excessive exposure to the sun and ultraviolet rays, atrophic skin diseases, and several conditions not amenable to irradiation (erythema multiforme, urticaria, parasitic disease, and psoriasis).

John B. McAneny, M.D.

GOITER

Intrathoracic Goiter. Frank H. Lahey. Jour. Am. Med. Assn., **113,** 1098–1104, Sept. 16, 1939.

The most common type of goiter which becomes intrathoracic is the discrete adenoma originating as a small single adenoma in the lower pole of the thyroid and gradually descending beneath the sternum and clavicle until it is no longer located in the neck but has so descended that it is now in the thoracic cage itself. The outflaring of the upper portion of the thoracic cage necessitates further and further descent of the spherical mass as its diameter increases.

Occasionally there will occur intrathoracic cysts of the thyroid, since thyroid cysts are brought about by liquefaction of the central portion of an adenoma until its solid portion is replaced by fluid retained by the fibrous capsule of the adenoma. This is not a common type of intrathoracic goiter. Next to discrete adenomas, multiple colloid adenomatous goiters, particularly

of the endemic variety, have been most prone to become intrathoracic.

The diagnosis of intrathoracic goiter can be definitely established by roentgenograms, which demonstrate the extension of the shadow of the thyroid into the mediastinum with or without lateral deviation of the trachea by the intrathoracic mass or anterior collapse.

No intrathoracic goiter of any considerable depth in the mediastinum should be removed without first introducing a rigid wall catheter into the trachea. It is possible to demonstrate a ligate both the superior and the inferior thyroid arteries in all cases before any attempt is made toward removal of the intrathoracic mass.

Large intrathoracic goiters can be extracted from the mediastinum without removing the chest wall if the proper procedure is followed.

CHARLES G. SUTHERLAND, M.D.

Toxic Goiter. Cecil A. Joll. British Med. Jour., **2**, 433–437, Aug. 26, 1939.

Every radiologist and radiotherapist should review this article for two reasons: first, the author presents a rather complete and careful discussion of toxic goiter, and, second, he disposes of the question of x-ray treatment of the thyroid in one short paragraph consisting of twelve lines.

The cause, incidence, pathogenesis, chemistry, and clinical features are discussed. Under the last heading ocular signs, tachycardia, nervous phenomena, blood, digestive, and metabolic changes are considered. Prognosis is said to be extremely difficult. Under the heading of treatment, x-ray therapy is disposed of as follows: "X-ray therapy is said to be able to reduce thyroid activity to any degree..... Its disadvantages are its unreliability, high mortality, and long interval before success is achieved or failure admitted..... X-ray therapy should be reserved, therefore, for cases in which surgical treatment has been refused."

The statement regarding high mortality is difficult of interpretation. It appears that a definite professional bias is manifested in this article.

Q. B. CORAY, M.D.

HYPOPHYSIS

Results of Ten Years of Roentgen Therapy of the Hypophysis. J. A. Huet. Bull. et mém. Soc. de radiol. méd. de France, **27**, 20–25, January, 1939.

Radiotherapy of the hypophysis is without danger and, properly administered, should produce no changes in the skin or loss of hair. Success depends largely on the reliability of the diagnosis, so that all clinical and laboratory examinations should be used to insure the correct diagnosis.

The action of radiotherapy is not primarily on the gland itself, but on the supportive periglandular structures, reducing inflammatory conditions and thus making possible normal function of the parenchyma.

The law of the increasing threshold holds true and the dose in successive series must be increased to produce the same effect. The author employs the factors: 150 to 180 kv., 8 mm. Al, 225 r per field, one field a day, three or four times a week. The total dose varies from 1,500 to 2,000 r. Six portals are used, two temporal, two frontal, and two sino-maxillary. Recently two new fields centered under the angle of the jaw have been used also. A second series can be given two months after the first.

The author briefly analyzes his cases and the causes of failure. Successful results are in the majority and, he concludes, radiotherapy should be considered in every case of hypophyseal dysfunction.

The results obtained were as follows: vasomotor troubles of the menopause (220 cases), 10 per cent failures; hypertension (15 cases), six complete successes, five partial successes, and four failures; Reynaud's disease, three successes, four cases improved but recurrent after one year, five failures; acroparesthesias (16 cases), four successful results, the rest failures which should probably have had treatment to the peripheral plexuses also; eclampsia, two cases, both successfully treated; diseases of fat metabolism (22 cases), all had losses in weight of from three to five kg. and some lost as much as 10 to 20 kg. In six cases with disorders of water metabolism, there were two successes, two partial successes, and two failures; in hypophyseal diabetes, three cases with two failures, and in insulin-resistant diabetes, four cases with four failures. There were eight cases of adiposogenital syndromes, with five successes and three failures; four cases of acromegaly, all benefited considerably, and 17 cases of thyroid dysfunction, hyper- and hypothyroidism, with 12 successes, two partial successes, and three failures.

S. RICHARD BEATTY, M.D.

THE JOINTS

Osteochondritis Dissecans Trochleæ Tali. Helge Myhre. Acta Radiol., **20**, 272–275, June, 1939.

While osteochondritis dissecans is a fairly common disease in the knee and elbow joints and occasionally observed in the hip and shoulder joints, it is rarely seen elsewhere. The author describes three cases in which the trochlea of the talus (astragalus) was involved. The site of predilection seems to be the median portion of the trochlea; there is no displacement of the detached bone fragment. Spontaneous healing is possible. Most of the concomitant clinical symptoms are due to the accompanying arthrosis.

ERNST A. SCHMIDT, M.D.

The Mechanism of Trismus and its Occurrence in Mandibular Joint Dysfunction. James B. Costen. Ann. Otol., Rhinol., and Laryngol., **48**, 499–514, June, 1939.

The author discusses the mechanism by which sensory irritation is reflected from various districts supplied by the third division of the fifth nerve to its molar branches supplying the muscles of mastication, and he uses short summaries of 23 cases of trismus to illustrate the various features. The results of roentgen study of the temperomandibular joints in trismus show: (*a*) asymmetry of

joint spacing; (*b*) limitation of the forward excursion of one or both condyles along the articular tubercle, and (*c*) occasional cases with unilateral trismus on the side opposite the lesion (result of voluntary guarding of the painful side).

LESTER W. PAUL, M.D.

THE LIVER

Parasites of the Liver and Spleen: A Radiologic and Anatomo-histologic Study, with Special Reference to Pentastomes. Giuseppe Bignami and G. M. Secomandi. Arch. di Radiol., **15,** 227–254, May-June, 1939.

The authors point out some of the characteristics by which cysts in the spleen and liver caused by pentastomes can be differentiated from those caused by distostomes, ecchinococci, and tænia solium.

E. T. LEDDY, M.D.

The Roentgen Diagnosis of an Infected Echinococcic Cyst of the Liver. V. Hormuth. Röntgenpraxis, **11,** 353–355, June, 1939.

A direct roentgenologic demonstration of an echinococcic cyst of the liver is possible, when the cyst contains air or when its walls are entirely or partially calcified. After rupture of the cyst, free air might be found in it, which allows the roentgen diagnosis of a liver abscess or an echinococcic cyst.

The author reports the case of a 51-year-old man with the history of a long-lasting gall-bladder or liver disease. The patient was admitted with a high septic fever and slight jaundice. Roentgenologic examination showed a normally functioning gall bladder without stones. The right diaphragm was considerably elevated, and fixed. Below it there was a cavity with air and a fluid level; it was thought to be in the anterior portion of the liver. The pre-operative diagnosis was liver abscess, because the complement fixation test for echinococcus was negative and because there was no eosinophilia. At operation the abscess was found. Microscopic examination proved it to be an infected echinococcic cyst.

HANS W. HEFKE, M.D.

THE LUNGS

The "Cut-off" of the Diaphragm Line: A New Diagnostic Symptom in Chest Radiography. Francis Polgár. Acta Radiol., **20,** 219–225, June, 1939.

If the right phrenicocostal sinus is shadowed, the diaphragm contour shows a feature characteristic of the increased density of the lung tissue: The contour is cut off at its point of intersection with the great interlobar fissure, *i.e.*, where middle and lower lobes meet (cut-off symptom). If the shadow in the sinus is caused by an accumulation of fluid, the basal medial border of the shadow appears quite different. In case of a typical cut-off, the border between free and shadowed parts of the diaphragm is sharp and coincides with the incisura interlobaris. The point of cut-off is located anteriorly, behind the anterior chest wall. In contrast to this, small exudates are, as a rule, found in dorsal regions and show quite different roentgenographic appearance.

ERNST A. SCHMIDT, M.D.

Bronchography. E. J. Gilroy Glass. British Med. Jour., **2,** 950, 951, Nov. 11, 1939.

The author opens his article by calling attention to the importance of determining the extent of a bronchiectatic or neoplastic process in the lung before surgical treatment is attempted. It is pointed out that lipiodol was originally employed as a therapeutic material but is now used mainly as a diagnostic aid.

The limitations of bronchoscopy are made apparent. The inaccessibility of some regions of the lung may be overcome when lipiodol and routine roentgenography are employed. Methods of filling the cavities of the various lobes are described. It is stated that two weeks must elapse between demonstrations of each region so as to allow elimination of the lipiodol used. Anteroposterior and lateral views are essential.

Q. B. CORAY, M.D.

PEPTIC ULCER

Liquid Colloidal Aluminum Hydroxide in the Treatment of Peptic Ulcer. Clement R. Jones, Jr. Pennsylvania Med. Jour, **43,** 468–472, January, 1940.

A brief account is given of the use of colloidal aluminum hydroxide in cases of peptic ulcer. X-ray films of the stomach before and after treatment are shown.

JOSEPH T. DANZER, M.D.

The Medical Treatment of Peptic Ulcer and its Complications. E. Meulengracht. British Med. Jour., **2,** 322–324, Aug. 12, 1939.

This article shou d be intensely interesting to radiologists for the reasons that, in the first place, they are associated with ulcer cases daily and, in the second place, as doctors, they seem subject to a high incidence of ulcer themselves.

The author states as his major premise that the ulcer case, both immediately following frank, gross hemorrhage and also in the stage of pain but no blood, should be fed on a varied and adequate diet. The bleeders are given plenty of food from the first day. This system has been employed since 1931 and conclusions are based on a series of 491 cases. The statistics regarding mortality, duration of hospitalization, and mental attitude of patients indicate the abolition of the customary starvation diet with its accompanying development of food-fear and apprehension.

The régime consists largely of puréed foods, bread and butter, meat, cheese, cocoa, and tea. Alkalies and belladonna are given as needed. The non-bleeders are put on a similar program. Worry, fatigue, and tobacco are found to be bad features in ulcer cases. The author cautions his patients to avoid these as far as possible.

Q. B. CORAY, M.D.

PNEUMOTHORAX

Collapse Therapy at Chicago Municipal Tuberculosis Sanatorium: A Critical Study of 8,083 Cases. Frederick Tice and Allan J. Hruby. Jour. Am. Med. Assn., **113,** 101–108, July 8, 1939.

This was a critical study of 8,083 cases, all the patients treated with collapse therapy from Jan. 1, 1931, to July 1, 1936, in their institution, and observed to July 1, 1937. Of these, 3,090 were treated more than three months, 337 were treated less than three months; pneumothorax was attempted on 330. The records of 742 were thrown out as not sufficiently complete for compilation and 3,584 were controls, a group made up of persons dismissed from the sanatorium as a routine, persons who refused pneumothorax or for whom it was attempted, patients with adhesions and patients obviously so non-co-operative that collapse was contra-indicated. The treated persons were all subject to some measure of collapse, either at the sanatorium proper or at the field collapse clinic, and the number included all who received treatment at both the clinic and the sanatorium under the plan of conjoined extramural and intramural collapse as practised over the period in question. The number of patients who were subjected to collapse in the six and one-half year period was 2,824.

Summarizing, 84.8 per cent of those with minimal, 80.4 per cent of those with moderately advanced, and 72.4 per cent of those with far advanced tuberculosis lost their bacilli permanently.

CHARLES G. SUTHERLAND, M.D.

Massive Pulmonary Collapse Treated with Artificial Pneumothorax: Report of a Case. Harold G. Jacobson, Samuel Gendelman, and Douglas Goldman. Jour. Am. Med. Assn., **112,** 2249–2251, June 3, 1939.

The prognosis as to life when pulmonary atelectasis is uncomplicated is usually excellent, although death may occur in debilitated subjects if collapse occurs in more than one lobe or bilaterally. The greatest danger in pulmonary atelectasis is the secondary development of pneumonia. Since pneumonia in itself is a serious disease, it becomes important either to prevent pulmonary atelectasis or to relieve it as soon as possible when it does occur.

The methods of therapy usually employed at present all more or less aim to release the secretions that may be obstructing the bronchi of the affected lung. These consist of (1) loosening of any tight dressings; (2) induction of deep breathing with 10 per cent carbon dioxide in oxygen every fifteen or thirty minutes; (3) induction of hard coughing, with the affected side uppermost, by severe manual percussion of the chest; (4) postural drainage of the bronchus by assumption of a 10 per cent Trendelenburg position of the bed from 15 to 30 minutes every three or four hours; (5) intravenous administration of a 10 per cent solution of sodium iodide in the loosening and expulsion of bronchial secretions, and (6) bronchoscopic treatment to remove any bronchial plug and rolling of the patient back and forth on the unaffected side.

Artificial pneumothorax on the affected side in the treatment of pulmonary collapse was first suggested in 1914. Little attention was paid to this valuable suggestion until 1927 and 1928, at which time several observers published successful results with this method.

The method is easy to carry out and mechanically rational. Since all patients with pulmonary atelectasis show increased negative intrapleural pressure, it seems likely that the cyanosis and dyspnea are due primarily to a displacement of the heart and great vessels and to an acute over-distention of the unaffected lung. In cases of atelectasis following abdominal operations, presumably resulting from bronchial obstruction, the marked increase of intrapleural negative pressure can serve only to draw the entire obstructing medium more firmly and deeply into the bronchus, thus perpetuating a vicious cycle. Introducing air into the pleural cavity serves to break the cycle, tends to push the mediastinum back to its original position, and probably enhances the expulsion of the obstructing medium.

CHARLES G. SUTHERLAND, M.D.

PSORIASIS

Roentgenologic Appearance of the Psoriatic Arthropathy. B. Büscher. Röntgenpraxis, **11,** 288–291, May, 1939.

The arthropathy found combined with psoriasis is a long known disease entity. The combination of psoriasis with any other joint disease is, of course, possible. Articular rheumatism, trophoneurotic arthropathies, and gouty arthritis may occasionally be found in a patient with psoriasis. The true psoriatic arthropathy is a rare disease, probably less than 1 per cent of all patients suffering at the same time from psoriasis and joint aches. Belot gives a classification of the disease in four stages: the first with only bone atrophy; the second with bone destruction; the third with hyperplastic changes, and the fourth with ankylosis.

It is thought that the psoriasis may belong to the group of lipoid diseases. The joint destruction may be comparable to similar changes found in disturbances of the lipoid metabolism.

The case of a 58-year-old man is described, who was suffering from psoriasis and what the author believes to have been a true psoriatic arthropathy. The roentgenograms showed marked destruction of the phalanges of the toes and fingers. Some of the roentgen signs suggested a gouty arthritis, which, however, could not be corroborated clinically.

HANS W. HEFKE, M.D.

RADIOLOGY, PRACTICE OF

New Lamps for Old. Sir Arthur J. Hall. British Med. Jour., **1,** 1123–1125, June 3, 1939.

The author of this paper refers poetically to a passage from the well known "Aladdin and the Wonderful Lamp," pointing out that when the people heard the merchant in the streets crying "New lamps for old"

they laughed. The "lamps" discussed by Dr. Hall are: the microscope, Harvey's discovery of the circulation of the blood, Lister's theory of sterility, the "magic of x-ray," and the electrocardiograph.

Of Roentgen's discovery the author says: "The x-rays provide a light which exceeds in value any that existed before." He makes, however, the reservation that roentgenography can never replace entirely the older methods of examination of the patient, in general, and of the chest in particular. In the case of the chest, the author betrays a small degree of doubt. He admits that certain conditions, *e.g.*, miliary tuberculosis, are easily demonstrated by x-ray examination while other methods are still indefinite. Reference is made, on the other hand, to a feeling on the part of some older members of the profession that the film should not be looked at until the physical examination has been completed.

The conclusion made is that controversial attitudes should be put aside and both methods used whenever possible, so that each may act as a check on the other.

Q. B. CORAY, M.D.

Co-operation by Roentgenologist and Laryngologist. Edgar R. Hargett. Ohio St. Med. Jour., **35,** 58, 59, January, 1939.

In this article 15 examples are cited in which the roentgenologist read films of sinuses, mastoids, chests, etc., in various otolaryngological cases without any knowledge of the clinical history or findings. The mistakes in diagnoses were all easily cleared up by re-interpretation with the knowledge of the clinical history at hand.

The author concludes that the roentgenologist and clinician (in this instance, an otolaryngologist), with their knowledge and information, should collaborate in order to arrive at more accurate interpretations. This, however, is an axiomatic principle in roentgen interpretation.

SIMON POLLACK, M.D.

RADIUM

Technic of Radium Treatment of Radiosensitive Neoplasms Involving the Anterior Vaginal Wall. Frank E. Simpson collaborating with J. Ernest Breed and James S. Thompson. Illinois Med. Jour., **76,** 344, 345, October, 1939.

The authors describe what they consider to be a new and safer technic for applying radium to neoplasms of the anterior wall of the vagina. Various older technics are discussed and the advantages of the new method given.

WILLIS A. WARD, M.D.

Radon Seeds: Physical Considerations: Do They Leak and do They Irritate Tissues? Edith H. Quimby and Arthur U. Desjardins. Jour. Am. Med. Assn., **112,** 1822–1830, May 6, 1939.

Radium itself is a metal, belonging to the same chemical group as barium and calcium. The nucleus of the atom is, however, unstable, and at some (entirely unpredictable) time it suddenly ejects a portion of itself. This portion, which is called an alpha ray or alpha particle, is exactly like the nucleus of a helium atom. In any given quantity of radium, every instant a certain percentage of all the atoms present undergo this transformation, the rest remaining completely unchanged. The apparent result of this is that the quantity of radium present gradually decreases. But it must be remembered that this gradual decrease is the result of a series of sudden transformations.

When a radium atom has ejected an alpha particle, what is left behind is no longer radium but a new element, radon. This element is a gas, belonging to the same chemical family as helium. Being a gas, it need not remain with the radium atoms but can float away, remain for some time in the air, or settle on some object. Radon is itself unstable. At some (also unpredictable) time after its formation, the radon atom expels an alpha particle. The residual atom is known as radium A and is another metal, belonging to the chemical group of selenium and tellurium. These metallic atoms settle on any nearby object, forming a film so thin as to be invisible. They, in turn, eject alpha particles, and this alpha radiation naturally appears to come from the object on which the radium A has settled; this is "acquired radio-activity." When radium A disintegrates, its product is another solid, as are all subsequent ones. This element, called radium B, belongs to the same chemical family as lead.

Radium B disintegrates in a different manner from the preceding elements; it ejects an electron, known as a beta ray, or beta particle. Accompanying this particle are rays of the same sort as roentgen rays; these are called gamma rays. The next substance, radium C, emits all three types of rays in its disintegration.

The three types of rays differ greatly in their penetrating powers. The alpha rays, which are helium nuclei travelling at high speeds, cannot penetrate to any appreciable distance in solid matter. Evidently they may be ignored in radiation therapy. The beta rays, electrons travelling at considerably greater speeds than the alpha rays, are more penetrating. Many of them will pass through several millimeters of tissue; they are stopped by 2 mm. of brass or 0.5 mm. of platinum or gold. They are of use in therapy only for extremely superficial conditions. The gamma rays are, like roentgen rays, electromagnetic radiations travelling with the speed of light, and they are very penetrating. Some of them can pass through several inches of lead. They are the ones which must be used to affect cells at distances of more than a few millimeters in tissue.

The problem of radiation therapy is to deliver a sufficient quantity of radiation to the cells it is desired to affect, without at the same time producing undesirable effects on other tissues. In radium therapy this implies an adequate amount of gamma radiation.

There are advantages in using radon. An amount of radium is specified in terms of grams (or milligrams) of radium element present in any given preparation. The amount of radon having the same gamma ray activity as 1 gm. of radium is called 1 curie; the amount

corresponding to 1 mg. of radium is 1 millicurie. One millicurie of radon can be compressed into much less space than 1 mg. of radium, so that radon sources can be made much smaller than radium ones of the same strength.

As soon as a radon source is separated from its parent radium it begins to deteriorate at the rate of 16.6 per cent daily. The day a source is prepared, its strength is measured by comparing its gamma ray activity with that of a known amount of radium sealed in a permanent tube. Thereafter its strength can be calculated at any time, since its hourly and daily rate of loss is known. Practical tables have been developed for this purpose.

A great deal of work has been done on proper methods of delivering desired doses in interstitial therapy (implantation of radon). It was necessary to eliminate all the beta rays and perhaps also the least penetrating fraction of the gamma rays. This work is reviewed in some detail. Radon seeds made of platinum and gold have been the most successful.

Investigation of radon seeds purchased revealed that the measurements of radon content made by the companies supplying radon to physicians were so inaccurate (sometimes as much as 30 per cent) as to present a greater problem than the leakage of the content, which did not average over 1 per cent.

CHARLES G. SUTHERLAND, M.D.

The "Tolerance Concentration" of Radon in the Atmosphere. John Read and J. C. Mottram. British Jour. Radiol., **12**, 54–60, January, 1939.

Cases of leukopenia in radium workers have been found, due to leaking radium and radon containers, indicating that radon may be absorbed into the body from the atmosphere. This paper represents an attempt to find what concentration of radon in the atmosphere is safe.

Methods of sampling the atmosphere are described. The results of air analysis from various places where there may be radon contamination of the atmosphere are given. It is not possible, however, to make any accurate correlation between these findings and the incidence of leukopenia in workers.

Experiments were made in which mice were exposed to varying concentrations of radon. A radon concentration of 5×10^{-9} Curies/c.c. was highly fatal, while 10^{-10} Curies/c.c. was not injurious. The air of the Joachimstal mines contains 2×10^{-11} Curies/c.c.

The air in radium safes has been found to have a very high concentration of radon. The draft produced on opening the safe door sweeps practically all of this air into the room.

The authors feel that the radon concentration in the atmosphere of radium laboratories should be kept below 10^{-12} Curies/c.c. Check measurements should be made from time to time. Safes containing radium should be artificially ventilated and the air exhausted outside the building.

S. J. HAWLEY, M.D.

ROENTGEN-RAY DIAGNOSIS

Some Contributions of Roentgen Rays to Diagnosis. B. R. Kirklin. Jour. Indiana St. Med. Assn., **32**, 677–679, December, 1939.

Kirklin gives a good description of the position held by the general practitioner and praises him highly for his ability to make correct diagnoses despite limited facilities. After nominal mention of the more common diagnostic uses of x-rays, he describes less familiar conditions.

Among the many causes of low back pain, congenital anomalies, tumors, and prolapse of an intervertebral disc must be considered and are discovered only by x-ray examinations. In the chest, tuberculosis is the most frequently encountered condition and the roentgen examination is the only means of accurately diagnosing, localizing, and determining the progress of the lesion. Pneumonia, bronchiectasis, and metastatic lesions may be identified by x-ray study.

The roentgen study of gall-bladder disease has increased in importance and it is regretted that this examination is requested only in those cases with definite history and findings of cholecystic disease.

The roentgenologist rarely sees an early cancer of the stomach; however, the general practitioner has a good opportunity of helping early discovery by insisting on roentgen examination of those patients with vague abdominal complaints.

The value of a negative examination is great, for the physician is then able with perfect confidence to assure the patient as to his physical condition.

JOHN B. MCANENY, M.D.

SARCOMA

Chondromyxosarcoma and Osteochondrosarcoma. L. E. Sorrell. Southern Med. Jour., **32**, 1046–1048. October, 1939.

Osteochondrosarcoma may be primary or may arise secondarily from a benign osteochondroma. The roentgenographic differentiation of benign osteochondroma, secondary chondrosarcoma, and primary chondrosarcoma is difficult. Traumatic myositis ossificans may also be confused with these tumors.

Two cases of chondrosarcoma at the knee are reported, characterized by an early erroneous diagnosis, refusal of the patients to submit to operation when first advised, a rapid course, and death from lung metastases within five months of operation.

Characteristic of osteochondrosarcomas is the predilection for youth, particularly when primary, the initial symptom of pain, or, when secondary, pain at the site of a previously painless tumor, and the presence of leukocytosis and fever.

Roentgenographically, there is a soft-tissue shadow next to the bone or next to a benign bone tumor. The periosteum is slightly raised, but when first seen, which is about five months after the onset of symptoms, the cortex and medulla are not involved. As the tumor grows the cortex and medulla are destroyed Patho-

logic fracture may occur in primary tumors but is rare in secondary osteochondrosarcoma.

JOHN M. MILES, M.D

Sarcoma of the Trachea: Report of Two Cases. Tobias Weinberg. Am. Jour. Cancer, **37,** 201–208, October, 1939.

The author reports two cases of sarcoma of the trachea which, together with previously reported cases, makes a total of 34 such cases recorded in the literature. Both of these cases were studied clinically and at necropsy. The tumors grow slowly and may be present for years prior to discovery. The tumors arise in the wall of the trachea and grow into the lumen as well as outside the trachea. They metastasize by direct extension and occasionally have more distant metastases. They are of relatively low malignancy, death usually being due to mechanical effects with production of chronic anoxemia and subsequent cardiac failure.

HAROLD O. PETERSON, M.D.

THE SINUSES

Bronchiectasis and Tuberculosis in Relation to Nasal Sinusitis. L. DeV. Chipman and R. J. Collins. Canadian Med. Assn. Jour., **40,** 557–561, June, 1939.

In 1914, Sir St. Clair Thompson observed that the amount of secretion in bronchorrhea was influenced by the treatment of the accompanying sinusitis. Later experiments definitely demonstrated a connection by lymphatic absorption and direct inhalation. In 1928, the authors concluded that many chest infections previously considered tuberculous were non-specific infections frequently associated with upper respiratory infection.

Roentgenology has been of great aid. In all patients with chest pathology other than tuberculosis, Manges routinely made sinus films. Eighty-five per cent of patients with chronic sinus disease presented roentgen evidence of lung changes. Quinn and Meyer found 77 per cent of chronic sinus disease associated with bronchiectasis. Clerf studied 200 patients with bilateral bronchiectasis and found 82.4 per cent with sinus infection. F. M. Hodges has taken a sinus film of every doubtful chest case for over a period of 15 years.

The authors observed, over a seven-year period, 4,005 new patients who presented symptoms suggestive of tuberculosis. Approximately 50 per cent were found to be suffering from non-tuberculous infections. From this group 597 were selected who presented symptoms indicative of sinusitis. Sinus films were made and 59 per cent showed definite evidence of sinusitis.

Nasal infection seems to be accompanied by a fairly definite picture on the chest film which is portrayed by increased density of the hilum and peribronchial and perivascular markings and characteristic shadows at the base of the lung. These basic shadows are confluent with the hilum shadow, extend downward along the border of the mediastinum to the diaphragm and outward toward the periphery along the diaphragmatic shadow, thus forming a triangular shaded area.

The authors mention many types of treatment, including x-ray therapy.

M. L. CONNELLY, M.D.

THE SPINE

Vertebra Plana (Calvé). H. von Hecker and K. Thews. Röntgenpraxis, **11,** 300–303, May, 1939.

The osteonecrotic spondylitis, called "vertebra plana," may be compared in its etiology and other aspects to any osteochondritis or aseptic necrosis. Deformities caused by the disease are not due to a lack of ability of the bone to regenerate, but rather to poor and late treatment.

The case of a seven-year-old girl is described who was found to have a collapsed fourth lumbar vertebra. The bony substance seemed to be squeezed outside the normal contour of the vertebra for a considerable distance. The discs were normal. After three years there was still a definite collapse, but regeneration had begun. Treatment was not started until more than six months after the onset of symptoms. This factor was probably responsible for the remaining deformity.

HANS W. HEFKE, M.D.

Roentgen Therapy and Chemotherapy in Pemphigus. Candido Maderna. Arch. di Radiol., **15,** 215–226, May-June, 1939.

The author reports three cases of pemphigus, one followed eight years, which were successfully treated by a combination of x-ray and arsenic. He used three fields each side of the spine in crossfire, giving one-third H.E.D. to each.

E. T. LEDDY, M.D.

Primary Pyogenic Osteomyelitis of the Articular Processes of the Vertebræ: Report of an Unusual Case. William H. Shebadi. Jour. Bone and Joint Surg., **21,** 969–976, October, 1939.

This is the report of a case of pyogenic osteomyelitis involving the inferior articular process of the second lumbar vertebra in which the condition was incorrectly diagnosed over a period of eight years. Reproductions of roentgenograms show the various stages in the progress of the disease, until the articular processes had practically disappeared.

Since osteomyelitis in the young usually occurs before ossification is complete, it is possible that the infection in this case occurred in an accessory ossification center for the inferior articular facet.

JOHN B. MCANENY, M.D.

A Contribution to the Knowledge of Scheuermann's Disease Combined with a Chronic Arthritis of the Spine. A. H. Lemmerz. Röntgenpraxis, **11,** 342–349, June, 1939.

Clinical and roentgenologic symptoms of Scheuermann's disease are discussed. The combination of

Scheuermann's disease and spondylosis deformans is mentioned. After consideration of the etiology of Bechterew's disease, case histories and roentgenographs of osteochondritis juvenilis dorsi and spondylarthritis ankylopoietica are discussed.

HANS W. HEFKE, M.D.

The Etiology of Spondylolisthesis. Martin Batts, Jr. Jour. Bone and Joint Surg., **21,** 879–884, October, 1939.

Batts has made a study of 200 fetal spines to disprove the assumption that spondylolisthesis occurs as a result of non-fusion of ossification centers of the lumbar vertebræ.

The incidence of spondylolisthesis is about 5 per cent.

There are three centers of ossification for each vertebra, one for the body and one for each lateral mass of the neural arch. The lateral masses fuse posteriorly at term or in the first year and the neural arch fuses with the body from the fourth to sixth year.

The defect in spondylolisthesis occurs between the superior and inferior articular facets and if the condition were a developmental defect this fault should be found in the lateral mass at, or shortly after, birth in 5 per cent of infants. The present theory presupposes two ossification centers for each lateral mass and their failure to fuse in spondylolisthesis.

In this study it was impossible to demonstrate separation of any lateral mass in the 200 subjects examined. It was, therefore, concluded that it was highly improbable that failure of fusion in the lateral mass accounted for spondylolisthesis.

JOHN B. MCANENY, M.D.

Congenital Malformation of the Cervical Spine (the Klippel-Feil Syndrome). J. Lavelle. British Jour. Radiol., **12,** 96–98, February, 1939.

A case is presented in which the patient had reached the age of 39 years before she was aware of the abnormality. Her only complaint was stiffness of the neck for three months. There was slight cervical kyphos and the chin was tilted to one side. The movements of the neck were diminished. There was no history of birth injury. X-ray examination showed extensive malformation of the cervical column.

SYDNEY J. HAWLEY, M.D.